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Composition and Classification of Wine.	Vit.	Rep.	1896
Description of Varieties of Wine.	"	"	"
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Fermentation; Pure Yeast; Color Grapes,	"	"	"
Nitrogen in Must and Wines,	"	"	"
Control of Temperature of Fermentation,	Bul.	117	1897
Unfermented Grape Must,	"	130	1900
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Manufacture of Dry Wines in Hot Countries;	"	167	1905
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California Yeasts,	"	"	"

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APPENDIX E TO THE BIENNIAL REPORT OF THE BOARD OF STATE
VITICULTURAL COMMISSIONERS FOR 1891-92.

WINE.

CLASSIFICATION—WINE TASTING—QUALITIES AND DEFECTS.

BY

PROF. G. GRAZZI-SONCINI,
Director of the Royal School of Viticulture, Alba, Italy.

TRANSLATED BY

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Berkeley, California.

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AUTHOR'S PREFACE.

ROYAL SCHOOL OF VITICULTURE AND ŒNOLOGY,
ALBA, PIEDMONT, ITALY, January, 1892.

A preface should give an immediate idea of what the author has proposed to do in writing his book. As Balbo rightly says in the preface to one of his books:

"It is the duty of every writer to give the reader a terse and clear idea of the work which he presents him. This sincerity benefits both: the reader, because it puts him in the position of knowing whether or not the book is likely to be of interest or utility to him; the writer, because, whilst it may reduce the number of his readers, it insures him more interested, attentive, and indulgent ones.

"The clearest and most sincere way of giving an explication of the object of a book is to tell how it was written."

Thus I will explain, as well as possible in a few words, why I have written this book, which treats especially of the classification, the qualities, and the defects of wine.

When I commenced to give particular attention to viticulture and œnology, I soon perceived that in œnology, and especially in that part which regards classification, qualities, and defects, all authors were not in accord in their use of terms to express the same characters. Thus, for example, some would mean by "sève," a slight sweetness in the wine; others by the same term would intend to express that character by which a wine of good quality affects the mouth and olfactory organs with a certain perfume, for a longer or shorter time after it has been swallowed.

I will say nothing of the classification of wines according to dishes, as wine to be drunk with oysters, fish, roast meat, etc., which shows a marked tendency to become a veritable chaos. In this classification, the work of Mr. Bertall, "La Vigne-Voyage Autour des Vins de France," is taken too literally.

How could one speak of the classification of wine, of its qualities, of its defects, without giving some explanation of the mode and proper conditions for tasting? It is for this reason that I have devoted a chapter to the tasting of wine, a chapter, moreover, of great importance, as it is by tasting, more than by chemical analysis, that we can best judge of the constitution and future of a wine. Who is a better judge than an experienced taster of the bad flavor produced in wine, for instance, by the tartaric fermentation, which even in its incipiency he can detect by a certain burnt taste, which, with the progress of the malady, gradually develops into an insupportable bitterness? Among these gradations of bitterness we do not find that slight pleasing bitterness peculiar to certain wines, such as Barolo and Gattinara.

Chemical analysis gives us the principal components of wine, and from the presence or absence of certain of these and from their proportions, some judgment may be formed of the character of the wine. The

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taster alone is able to detect diseases at their incipiency, and, one might almost say, before they have commenced, whilst the chemist can only state the final consequence. In other words, one might say that whilst the chemist is limited to making a diagnosis, the taster can make a prognosis.

In the case of some defects of wine, I have not confined myself to a simple definition or description. I have also added notes, brief in some cases, more extended in others, on the determining causes and the means of prevention or cure. I have done this, believing it would be useful to the taster or the dealer, who is not always fully informed on all the details of technical œnology. With this information for a guide, he will be better able to judge of the relative gravity of this or that defect, and the dealer especially will be able to judge of the utility or inutility of attempting to cure a wine of a certain defect.

I have also tried—wishing to be useful to the greatest possible number of readers—not to neglect a secondary part, which has its importance in tending to make the consumer better appreciate the wine he drinks. Profiting by the *Consigli di un amatore di vini*, I have indicated the form of glass to be used with each kind of wine, how wines should be presented and distributed during the repast, and how they should be drunk. In this part, which I have called secondary, it is not to be denied that fashion is the determining factor.

And now the reader may judge if I have succeeded in my intentions. Even though his judgment should not be favorable, I shall consider myself fortunate in being the first—as far as I know—to call attention, in an extended manner, to this part of œnology, which in former treatises on the subject has been but lightly touched upon.

G. GRAZZI-SONCINI.

TRANSLATOR'S PREFACE.

AGRICULTURAL EXPERIMENT STATION, UNIVERSITY OF CALIFORNIA,
BERKELEY, CAL., September 16, 1892.

Professor Grazzi-Soncini's book, which has been already translated into French, fills a void in the literature of œnology. The part dealing with the defects of wine, the diseases to which it is subject, and the methods, when such exist, of remedying these diseases, will perhaps be of the most practical value to the wine grower. The part which regards tasting and classification, however, is worthy of careful reading, and many hints may be drawn from it that will be of use towards the attainment of that most desirable object: the production of constant types of wines—an object which is too little studied in California, but on which our hopes of building up a trade in high-class wines very largely depends.

Many of the numerous terms which the French and Italians have invented for the technical consideration of wine it is impossible or difficult to translate into English, and for this reason the translation necessarily lacks some of the scientific precision and clearness of the original. I have however attempted, wherever possible, to give the English equivalent of the term used by the author, and have also given the French term, in this way making a glossary in the three languages, which may possibly be of use in developing a uniform set of technical terms on this subject in our own language.

If this book should be of any use to the wine maker, and especially if it should call the attention of non-wine-drinking people to some of the uses and beauties of wine which they did not suspect, the translator will feel amply repaid for his trouble.

F. T. BIOLETTI.

WINE AND THE ART OF WINE TASTING.

By G Grazzi-Soncini.

INTRODUCTION.

Wine is simply the juice or must of the grape after it has undergone the process of fermentation.* This may be considered as the most natural and exact definition that can be given of it. It is the definition accepted by the law.

On account of the prevalence of sophistications and the considerable amount of wine that is now made from dried grapes and other saccharine fruits, a more particularized definition of wine is now given; it may be formulated as follows:

By wine is understood that liquid which is obtained by the alcoholic fermentation of the juice or must of fresh grapes. This must may be fermented in contact or not with the pomace or solid portion of the grapes, without, however, the addition of any extraneous substance or even of substances chemically the same as those that the grapes themselves contain. The addition of the latter is considered by many as an adulteration, because it changes the quantitative composition of the must, and consequently of the wine.

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*Although as Gautier writes, "Wine is a very complex body, and so delicate that the work of chemists, so far, has been but an outline of what there is to do in the study of it," I think it will be useful, because it will give a more complete idea of the subject of our remarks, to give a list of the principal components of grapes, or must, and of wine:

A. Solid Bodies.

Stems: Lignose—Tannin—Albuminoids—Organic salts and acids—Mineral salts and acids—Chlorophyll—Gummy matters—Phosphates—Potash, lime, magnesia, silica.

Skins: Cellulose—Œnocyanin—Œnorubin—Tannin—Cream of Tartar—Catechin—Quercite (?)—Waxy matters, ferment germs—Etherous and aromatic principles—Nitrogenous substances—Phosphates—Potash, lime, magnesia, iron, silica.

Pulp: Cellular parenchyma—Nitrogenous substances—Cream of tartar—Gum, pectin, dextrin (?)—Gases, nitrogen, carbonic acid—Divers salts.

Seeds: Lignose—Fatty matters—Nitrogenous substances—Gum—Starch—Phosphates—Divers salts—Tannin.

B. Liquid Bodies.

Water—Glucose—Levulose—Divers nitrogenous substances—Saccharose, dulcite—Cream of tartar—Tartrate of calcium—Tartaric, malic, and racemic acids—Halogen acids (traces)—Ammoniacal salts and organic derivatives—Phosphates, sulphates, nitrates—Potash, lime, magnesia.

C. Gaseous Bodies.

Carbonic anhydride—Nitrogen—Hydrogen sulphide.

Elements of Wine (Red Wine).

Water—Alcohols: ethylic, propylic, butylic (amylic?), caproic, œnanthilic, caprylic, pelargonic, capric.

Higher alcohols—Glycerine—Isobutyl—Mannite—Glucose—Levulose—Inosin—Gum—Pectic matters—Essential oils—Furfurol—Aldehyde—Acetal.

Ethers: acetic, propionic, butyric, valerianic, caproic, lauric, myristic, palmitic, stearic.

Acids: carbonic, acetic, propionic, butyric, caproic, œnanthylic, caprylic, capric, lauric, myristic, tartaric, racemic, succinic, malic, tannic, sulphuric, nitric, phosphoric, silicic, chlorhydric, fluorhydric. These acids are either free or combined with the bases: potash, soda, lime, magnesia, alumina, iron oxide, manganese, ammonia, volatile bases of the pyridic series.

Albuminoids—Coloring matters.

Who first made wine is not known. The history of its manufacture, like that of many other fermented beverages, extends back into the mists of ages; nothing, therefore, is known about its first use. Tradition and mythology give several accounts of its first appearance, but they are of a very contradictory nature.

Of one thing we may be sure, and that is that from the first, man has asked himself the question: Is wine a real benefit? A question that has not yet, perhaps, been answered to the satisfaction of some.

Even at the present day it is not possible to give a satisfactory, definite reply to this demand, unless we look at it from an economical standpoint, in which case there can be no doubt of its utility, as it is one of the principal sources of national wealth in every country where the grape can be grown.

We must therefore consider it from this point of view, otherwise its real utility to man might be contested.

It is said that wine incites man to anger, licentiousness, murder, and in general subjects him to a thousand depraving temptations.

"*Il vino e il veleno piu teribile per la società. Nè i fulmine di Giove, nè la spada di Marte, nè i baci di Venere hanno fatto tante vittime quanto Bacco coi calici spumante.*"—Bizzozero.

Alcohol, the moment it enters the cells and nervous filaments, revives their functions and excites and stimulates their action; this state of exaltation passed, however, if more alcohol is imbibed by the cells and nerves a period of exhaustion supervenes. The presence of this foreign body in the organism, tainting the blood and diffusing its vapors through the substance of the brain, interferes with the chemical processes of the body, augments the resistance to the nervous movements, and engenders that particular kind of poisoning known under the name of intoxication.

It was owing to wine that Ham was cursed and became the servant of his brothers' servants. It was owing to wine that the ancient Persians, Lacedemonians, Romans—active, vigorous, and glorious by a thousand splendid victories, as long as they possessed the virtue of sobriety—declined and fell when—

Della stoica incude
Spessa nel vin tempravasi
La rigida virtude.

But that was the abuse not the use of wine.

Every one should know that wine, drunk in moderation or with *temperance*, favors and augments the secretion of the gastric juices and so aids digestion; it excites the imagination, awakens the memory, dispels care, restores the physical force, and renders the movements of the body active and vigorous.

A proof of this, if one is needed, is furnished by the fact cited by all writers on hygiene, that if in the war of 1870–71 the German army was able to sustain the fatigues of the campaign and sieges, always remaining in good health, it was because they were invading and conquering a wine-producing country.

Bacchus is the "Dio salvatore." Plutarch, in the life of Cæsar, mentions that the whole army of the General was once afflicted with a disease which Cæsar cured by allowing all the soldiers to get solemnly drunk. From that day they all commenced to recover.

Certainly among the curative resources at the disposal of hygiene and medicine there is none more frequently used than wine. We always, as it were by instinct, say to a convalescent: "You should drink wine."

Hippocrates says: "Wine is a liquid marvelously adapted to man, well or ill, providing he take it at the proper time and in quantities suitable to his constitution."

Liebig, too, is of the same opinion, for he writes: "Wine is unsurpassed by any product, natural or artificial, as a restorer of the vital forces when they are exhausted; it animates and revives the saddened spirits, it serves as a corrective and antidote in all irregularities of the animal economy, which it preserves from the passing ills to which inorganic nature subjects it."

Wine considered from an alimentary point of view has its chief importance in the union of alcohol with an acid liquid; the acid moderates the too energetic action of the alcohol, especially its action on the nervous system.

The tannin and coloring matter, when present in due proportion, exercise a very favorable influence on the stomach by animating the energies of the digestive functions.

The aroma, the bouquet, the "sève" of a wine are also useful, as many facts tend to prove, among others, the fact that well-flavored substances in general have a favorable influence on nutrition.

Wine has a density nearly equal to that of water, and is absorbed into our system with much less rapidity than spirits; this fact is of great importance to the animal economy, because the effects of wine are thus felt for a longer time and without the danger accompanying the rapid effects of brandy.

Wine is absorbed by our digestive organs without any change but that of being mixed with the gastric juice. There is no need of the intervention of the digestive ferments to facilitate the absorption of the wine in its last office of nutrition. This explains its utility in certain diseases.

The complexity of the organic matters that enter into the composition of wine, which up to a certain point resembles that of the human body, explains its restorative action in the case of individuals weakened by anæmia or insufficient nourishment, etc.

Wine, then, is produced and drunk, and of all fermented beverages it is the most healthful, and the one that most harmonizes with our organism. If nature had gifted man, as it has all other animals, with a surer instinct in the choice of the food that was best suited to his constitution, certainly without any hesitation among the first substances he would have selected wine; however, having a less reliable instinct than he might have, he has allowed himself to be greatly influenced by tradition and imitation in the choice of his beverages.

I.

CLASSIFICATION.

Of the numerous classifications that have been made, and that might be made, of the various and diverse wines produced in the different wine-growing regions, that is to be preferred which, up to a certain point, can be considered as the most natural, by giving an immediate idea of the principal characters presented by a certain wine or category of wines.

Carpené very justly considers the classing of wines according to different dishes or repasts as misleading and hurtful to the trade; for, as he well remarks in one of his articles, if this classification should be carried out we should have tripe wine, cheese wine, macaroni wine, etc. As every one knows, the order of wines and dishes through the repast is influenced by fashion and caprice. To-morrow, perhaps fashion will oblige us to imitate northern nations and Americans in our "cuisine," and then we will be obliged to drink champagne through the whole dinner; thus champagne must be successively known as an oyster wine, a soup wine, a roast wine, and heaven knows what else.

Not long since I was at a banquet, and by chance was placed next to a certain high functionary who was to commence the series of toasts. On the appearance of the roast our high functionary prepared himself. "But how is this," he exclaimed to a neighbor, "do they not give us champagne now?" "They serve the 'roast wine' now," replied the other. "Roast wine," cried the surprised high functionary, "but at court they serve champagne with the roast." Champagne was afterwards brought, and then the eminent personage was able to get up and make his toast, a very appropriate and happy one. I cannot say what influence the "roast wine" may have had on it.

This classifying by dishes is certainly all wrong, but if we should ask ourselves the question, as an amateur does in the wine taster's *vade mecum*, "*La vite ed il vino*," "When should one drink wine?" the answer most certainly would be, "Whilst eating." Without a good selection of wines the most perfect bill of fare loses all its value.

High-class red wines should not be drunk before they have been eight or ten years in bottle. Before that they may be rough, and not particularly pleasant to the taste. Very fine white wines, too, should be well aged, otherwise the sugar, of which they contain a certain amount, will not have been all transformed into alcohol, and lessens their strength and bouquet.

A natural, primary, and main division of the various wines may be made with reference to their color, viz.:

WHITE AND RED WINES.

It should be stated here that this general division rests not only on the color that the wine may have, or on the presence or absence of œnocyanin in its composition, but on other characteristics in which a white wine differs greatly from a red.

This division is of no little hygienic importance, wines of different color having as distinct effects on our constitution as wines of different age, alcoholicity, or acidity.

White wines, as is well known, are obtained from white grapes, or from red grapes which, instead of being crushed and fermented in a mass, are pressed, and the must fermented separately; that is, not in contact with the pomace or solid parts of the grapes.

I call attention to the fact that white wine can be made from red grapes, because wines so made have exactly the same action on our system as have white wines made from white grapes.

Certainly the following from Guyot is very true:

> Wine which has been fermented in contact with the stems, skins, and seeds of the grapes is very different from that which has been fermented separately. The latter wine is white, the other red, and the antithesis, though expressed here simply by the opposition of color, does not consist in the least in this difference of color, which is only an accident. The real difference consists in the special and often opposite hygienic qualities of these two kinds of wine. Nowadays they make red wines which have all the hygienic properties of white wines, and it is possible to produce white wines which would have all the hygienic properties of red. All that is necessary to obtain this last result is to ferment the must of white grapes with the skins, seeds, and stems, in the same way as red wine is treated; in this way all the effects are obtained of a rapid decomposition and solution by maceration of the principles and products which are not found in the juice of the grape. * * *
>
> I insist on the true distinction of wines obtained by the fermentation of the juice of the grape completely isolated from its accessories, and those made by fermentation of the juice, together with all, or at least part of the rest of the grape—a distinction quite independent of the color. Nothing is more alien or of less importance to the quality of a wine than its color. It may be a sign—an indication—but it is never a quality of itself. By the majority of consumers color is looked upon as a guarantee of the purity, quality, and strength of the wine. It is on account of this considering color as a sign of quality that unscrupulous dealers make use of it to commit innumerable frauds.
>
> White wines are in general diffusible stimulants of the nervous system; if they are light they act rapidly on the physical organization, of which they intensify all the functions. It seems that they escape just as quickly through the skin and mucous membranes, and, above all, with the urine; their action, then, is of short duration.
>
> Unlike white wines, red wines are tonic and persistent stimulants of the nerves, the muscles, and the digestive organs. Their organic action being slower is more prolonged; they do not unduly excite the perspiration nor the excretions, and their general action is astringent, persistent, and concentrated.
>
> Moreover, the common opinion, founded on daily experience, leaves no doubt of the real difference, in their sensual and organic effects, between white wines and red.

Of equal importance are the following words of Dr. Gauber:

> If one should divide the grapes gathered from a vineyard of the "Graves" of the Gironde into two parts, and of one make white wine and of the other red, and then, at the end of four years, make a careful tasting of these two wines which have been carefully treated during these four years, what will be the result? Made from a raw material apparently identical, will they be equally developed and equally mature? The white wine will have aged the most.
>
> Will they produce the same effect, the same degree of stimulation, on our organs? Let us collect the sensations produced by one and the other in the order in which they are produced.
>
> 1. A glass of white wine, well made and dry, the moment it enters the mouth develops a bright and penetrating aroma, and leaves, in passing, an impression, agreeable it is true, but fugitive and almost hot. Hardly has it reached the surface of the stomach when it causes a feeling of warmth which, in less than ten minutes in the case of certain healthy but impressionable constitutions, becomes very intense. Sometimes the action, by sympathetic radiation, is reflected from the stomach to the head with the promptitude of the electric fluid. Generally, after an hour or less, a sensation is felt as of a pressure either on the two temples or around the whole head; the hand is instinctively passed over the forehead as though to free it from some load. Sometimes a feeling of painful fullness of the brain accompanies these effects. The irritation is communicated from the gastric and nervous centers to the whole body. It shows itself by increased warmth, often irregularly distributed, of the body (with irritable people the palm of the hand often becomes unpleasantly hot and dry); by a need of movement, of displacement rather than of exercise (with people of the disposition mentioned above this need is shown by an internal agitation, by slight muscular tremblings accompanied by shooting pains that strike, with the rapidity of lightning, different parts of the body).

At the end of two or three hours, more or less, according to the temperament and susceptibility of the individual, the irritation passes away and the taster finds himself in the same condition as before, with or without a certain feeling of lassitude or sadness.

2. If the white wine is replaced by a red wine of the same vintage, and taken at a proper temperature, it will leave in passing a distinct impression on the two senses of smell and taste of a soft aroma; its fluidity in the mouth is less, and though it feels more material, so to speak, it leaves a less intense feeling of dry heat. Its contact with the stomach produces a softer and more gradual impression.

The organ is still warmed, but in a more vital manner, as it were. As to the sympathetic propagation of the stimulating action towards the head, it still takes place, but without the nervous phenomena of pressure and pain; the brain is gently excited. Its extension to the organs of the senses, if it takes place, is no longer betrayed by the need of displacement and agitation, but by a strengthened desire for exercise, which is very different. The duration of the stimulation is more prolonged and ceases insensibly, so that the most attentive observation cannot detect the exact time at which it ends.

Here is, we believe, the sufficient explanation of the difference of effect observed between white wine and red wine—the first (white wines of Graves), produced by fermentation of the must separate from the pomace, contains about 4 to 6 per cent of extractive matter and tannin; the second, 8 to 11 and 12 per cent of the same matters.

It is to this difference in the proportions of the rough and astringent matters of the wines that we attribute their different effects.

In the red wines the pressure of the alcohol on the nervous system of the stomach is softened by the interposition of more abundant tonic and extractive matters; the effect is thus slow and successive. In white wines it is almost immediate, and therefore stronger and less lasting.

Each of these large groups into which the various wines may be divided is susceptible of three subdivisions, which are sufficiently natural, as they give immediately some idea of the quality of a wine which enters into any one of them.

These three subdivisions are the following:

1. Table wines.
2. Dessert or alcoholic wines.
3. Blending or cutting wines.

1. *Table Wines.*

These wines may be of higher or lower quality, according to the locality in which they are produced, and to the care that is taken in their making and after-treatment; they must not be sweet nor too alcoholic; not aromatic nor possessed of too pronounced a bouquet, though those of higher quality may be slightly aromatic; they must not be too rich in color, too astringent, nor too acid; they ought not to be harsh nor of too heavy body, that is, too rich in extractive matter.* A wine of this group should be clean tasting, and should form an harmonious whole, agreeable to the palate and stomach, so that it can be drunk with pleasure. These wines are healthful, because they favor digestion, and a certain quantity of them can be taken without producing intoxication or other physical disturbance.

Concisely the characters of a typical table wine may be described as follows:

Light but not poor in alcohol; not the slightest tendency to sweetness; pleasing but light and delicate aroma and flavor; nothing excessive, but complete harmony of all parts. A full and generous homogeneity; limpidity; constancy of type. Though in the matter of dishes variety is both useful and pleasing, it is different with wine where constant uniformity of type is necessary.

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* "In the middle of the seventeenth century England consumed the light wines of France, and, as Gladstone says, they laughed and sang in those days in the British realm. The wars between France and Great Britain breaking out, the French wines were prohibited and in their stead the heavy wines of Spain and Portugal were imported; they still drank as much, continues Gladstone, but they sang no longer; to laughter succeeded quarrels and base deeds."—R. Dejermon.

As in this class of wines are comprehended all qualities from the finest to the most ordinary, it is easily seen that other distinctions can and must be made, in order that the wines, for example, of Barolo or Chianti, shall be distinguished from wines produced in some less favorable locality.

The various wines that enter into the category under discussion can be naturally and conveniently classified as follows:

A.—Superfine, or high-class wines; the "Grands Vins" of the French.
B.—Fine wines.
C.—Fine common wines.
D.—Common wines.
E.—Low-grade wines.

This classification, as Polacci would say, has nothing imaginative or strained about it, as it simply represents the wines that we really have and of which we make use in commerce.

I will now try to give, not a definition, because the name of each class is of itself a definition, and should give a fair conception of the distinction to be made between the several classes, but an idea regarding the characteristics which have served in grading the wines which we actually produce in Italy.

A. *High-class Wines.*—These are wines which are produced in certain spots, or rather which are obtained from certain varieties of grapes, grown in especially favorable conditions of climate, and more particularly of soil, compared with those of the circumjacent vineyards; wines which also, it may be said, are the product of an almost infinite series of careful treatments, beginning in the vineyard and continued through the vintage and during the whole time, which is certainly not brief, of their conservation; wines, in short, which unite in themselves all the characteristics and qualities which should be found in a fine wine, united with the greatest delicacy and fragrance of aroma and freshness on the palate. An Italian wine which belongs to this class is the Chianti di Brolio. Of the French wines of Bordeaux, or more precisely of the Médoc, there are Chateau-Lafite and Chateau-la-Tour, the latter of which is distinguished from the former by a slightly heavier body and a more pronounced flavor and aroma.

B. *Fine Wines.*—These are wines which approach very nearly to the preceding class, but are, nevertheless, somewhat inferior to them, either in delicacy of aroma or in some other quality; very often they lack or are deficient in the freshness which distinguishes the first class. These wines are very often the product of grapes grown in the neighborhood of the vineyards producing the first-class wines which have given renown to the locality, but they may be made from grapes grown in other localities. To this second class belong, for example, those wines of Chianti which resemble greatly in character the Chianti di Brolio, but do not equal it. In the same way among the French wines of the Médoc, Saint-Julien and Saint-Estephe approach but are not equal to Chateau-Lafite.

It may very possibly be that some of the wines of Chianti exhibit qualities which place them, so to speak, in rank with the Chianti di Brolio; then from the second they must be promoted to the first class, as is the case with Chateau-la-Tour, which, though somewhat different, is deemed worthy to stand in rank with Chateau-Lafite and the other two, Chateaux-Margaux and Chateau-Haut-Brion, which together form the four "grands vins," high-class wines of the Gironde.

C. *Fine Common Wines.*—In this third category are placed those wines which are intermediate between the fine wines and the common wines. This class of wines can be produced in large quantities in Italy, as there are numerous regions both in the hills and plains which present the requisite favorable conditions.

The wines in question generally lack or are deficient in delicacy; with time, and sometimes, too, with a little artificial aid, they acquire some aroma which is not, however, always very delicate. These wines form, or ought to form, the bulk of our export trade; but if we wish to do a steady trade we must set ourselves diligently to make and properly handle these wines. To do this the producers must abandon the idea of making high-class wines, and confine themselves to wines of this kind.

The wines of this class produced in Italy, especially by those who have recourse to artificial additions, or who do not well understand the processes of wine making, present a certain dryness to the taste which is not exactly pleasing.

The taster will pronounce them sound wines without any particular defect, but he is not quite satisfied. This may be owing to an artificial aroma, or to the addition of alcohol; it may be caused by heating, or by a too violent fermentation, to the grapes having been picked at the wrong time, or to an injudicious correction of the must, or—but as this is not the place to try to account for it it will suffice to state the fact.

Such artificial aids, then, as the addition of drugs, the drying of the grapes, heating, etc., should be abandoned, and instead a judicious choice of vines, or a blending of grapes or wines substituted; in this way it will be possible to deliver to the trade wines which have a sufficient freshness of taste and frankness of flavor; they will be to a certain extent smooth and delicate, and will possess more or less of that fruity taste so much liked by consumers.

D. *Common Wines, or Wines of the Plains.*—This is a class of wines of which it is not very easy to give a definition or to point out its exact limits in order that it may not be confused with the preceding or comprehended in the following class. To prove that this is a real difficulty it will suffice to quote the eminent agriculturist, F. Re: "I have sometimes drunk wines made from grapes grown in a naturally clayey soil, subjected to irrigation, which were very good, and some even which seemed to be of superior excellence."

I should therefore state that all wines grown on level ground cannot be classed as common wines; even on the plains, when the climate and especially when the soil and the variety of grapes are particularly favorable, choice wines may be produced which are worthy to figure in the preceding class.

The division or class of common wines comprises all those wines consumed in the largest quantities, and which, because of the ease and economy with which they are produced, can be sold at a low price, so that they find steady consumers among the working classes, who consume, after all, the greater part of the product of the vineyards.

These wines are most commonly the product of grapes grown on the plain, either in vineyards or associated with other crops; this does not exclude the possibility of producing such wines from grapes grown on hills, and especially when the exposure is unfavorable, or when the nature of the soil is unsuitable, or when, on account of the ignorance of the grape grower, who prefers quantity to quality, he plants by preference those varieties which give an abundant crop of very inferior grapes. Wines of this class have very poor keeping qualities, lasting two years at the most, and in general in aging, with the exception of those which are very rough and astringent, deteriorate instead of improving.

These wines are sufficiently alcoholic, but owe their conservation less to their alcohol than to their acids, among which, with many of them, must be included carbonic acid. To their acids, also, they owe most of their hygienic value, which is to aid in the digestion of the food consumed by the laborers who drink them—food which is naturally difficult of digestion, and rendered more so by its ill preparation.

These wines are more nutritious than are those of the preceding class, containing, as they do, larger quantities of albuminoids, in which grapes from the plains usually abound. The reason of the greater abundance of nitrogenous matters in inferior grapes is the natural fertility of the soil on which they have been grown, or the fact that this ground has been manured with nitrogenous fertilizers, with the idea of increasing the bearing of grapes or the production of wood and foliage.

These wines are naturally very variable, differing greatly according to the conditions of soil, climate, and aspect under which they have been produced. To further increase this variability man does his best, seeming to take a delight in practicing methods of wine making that are apparently ingeniously calculated to spoil the wine.

A wine of this class should be of easy digestion, and easily consumed in moderate quantities, without affecting the head or the stomach. It should be smooth, clean tasting, well fermented, with a certain amount of flavor and acid, and should show none of the effects of secondary fermentations to which these wines are so subject; finally, it should possess a good, bright, but not deep, color.

I have said a wine of this class "should be" all this, because only too often, on account of careless making or improper handling, they are anything but healthful; they are, on the contrary, heavy and indigestible, causing, even when used sparingly, disturbances of the head and stomach; they are heavy-bodied wines, and so thick as to be appropriately called by some people, "vini carnosi;" their defects are usually due to the vessels in which they have been made and kept, to bad fermentation, or to the addition of substances which have been put in with the intention of preserving the wine, or of masking its defects. They are often costive and overcharged with tannin and coloring matter, recalling, the moment they touch the palate, the flavor of ink. Their color is generally unstable and dull.

E. *Low-grade Wines.*—These wines occupy the lowest grade on the œnological scale, that is to say, among natural wines. In drinking one of these wines one asks himself if it is really a wine or not rather a piquette or mixture of water and wine, with superabundance of the former. Except color, these wines are deficient in all the elements proper to wine. They must be consumed promptly during the winter, or they cease to be wine. Generally, to render them drinkable at all, they must be left for some time on their pomace, or on that of better wines; or else they can be cut with other wines, or be given the treatment usual in Tuscany, known as the "governo."

When these wines are sound they do very well for cutting with other wines, thus making a blend which can be classed with the common wines, or even sometimes with the third class, or fine common wines.

2. *Dessert or Alcoholic Wines.*

This class includes all those wines which the French call "vins de luxe," and therefore champagnes and other sparkling wines, which, however, are, unlike most of this class, of relatively low alcoholic strength.

Sparkling wines are placed here because, as a rule, they are of high cost, and therefore "vins de luxe." However, we are now producing natural wines which are afterwards artificially made sparkling, at a much less cost; and this industry is assuming such proportions that it cannot well be overlooked.

Apparatus of different kinds for the production of sparkling wines have been known and used for a long time in France, Germany, and Austria.

Latterly the practice of artificially making champagne from natural dry wines has been extensively followed in Italy; this is due to the invention of the apparatus of Carpené, which possesses above all previous systems the advantages of simplicity and cheapness. This system has rendered possible the production of good sparkling wines at a moderate cost.

With this explanation regarding champagne, and the reason for placing it in this class, I pass to those wines more properly belonging to it, and here give Polacci's definition of "vini di lusso."

These wines are nearly always alcoholic, more or less aromatic, and are drunk, as a rule, after dinner, on which account they are called by foreigners dessert or after-dinner wines. They are, so to speak, concentrated, and are sipped from small glasses like cordials, for which reason the French know them as "vins de liqueurs." We know them as "vini di lusso," because they are certainly not necessary beverages, and from their high cost are usually reserved for the tables of the rich.

The many and diverse wines of this class can be divided, or rather united, under the following heads: Sweet Wines; Alcoholic Wines; Sparkling Wines.

In this class are wines so well known, and of such special character, that it is difficult to class them together, and each is usually spoken of by itself as almost forming a class apart; as with the wines in the first class, the "grand vins," their qualities and peculiarities are so well known that their names alone is a sufficient description; such wines are Marsala, Lacrima Christi, Vernaccia di Sardegna, Malvasia di Lipari, etc.

3. *Cutting Wines.*

These wines are rich in alcohol, coloring matter, and body, but often deficient in acid; they cannot be drunk alone, and the only reason for producing them is that there are localities which produce wines which are thin, poor in color, weak in alcohol, and generally lacking in those qualities which wines of this class have in excess. A mixture of these two kinds of wine, each of which alone is of little value, produce a wine which is sustaining and nutritious, and especially suited to the needs and means of the laboring classes. The better kinds of these wines may even be blended to form a wine which might be placed among the fine common wines, or third class, and not unworthy of the honor of bottling.

At the present day the French wine merchants use large quantities of cutting wines imported from Italy, Spain, and Dalmatia. Before the invasion of the phylloxera, their blends were made with the wines of Roussillon, Languedoc, Pyrenées-orientales, Aude, Gard, Tarn, etc., all wines rich in coloring matter and alcohol, solid and heavy-bodied, and at the same time smooth, delicate, and with a characteristic and persistent aroma which is very pleasing.

Here is, for example, a blend or mixture of different wines formerly much in vogue in France:

Wine of Roussillon	30 litres.
Wine of Narbonne	60 litres.
Wine of Cher	30 litres.
Wine of Poitou, blanc	60 litres.
Wine of Bourgogne	30 litres.
Wine of Pique-poule, at 15 per cent	15 litres.
Total	225 litres.

A French writer thus justly expresses himself: "After the invasion of France by the phylloxera, commerce drew contributions from all wine-producing regions; science was also brought to its aid; an immense productive movement commenced, not only in France, but in foreign countries, and now wines flow in from all parts, from Spain, Italy, Austria, Greece, the Crimea, and even from Australia; wines of all kinds, which, passing through the skillful hands of our merchants, there receive the official seal, the inimitable touch, which serves them for passport to the wine connoisseurs of the entire world." Further on we read: "In this combination each region plays its role, and helps towards the final result that we desire to obtain; from Italy the blend obtains strength, extract, body; Spain supplies softness and fruitiness; our own wines add piquancy, and economize on the price of production."

In whatever way the cutting is done, and whatever the combination adopted, the following may be taken in general as the composition of most blends:

One third wine of Italy;

One third wine of Spain;

One third "petits vins" of France, or wine made from dried grapes.

Cutting wines are then of no little importance to wine growing in France, or rather to the French wine trade; why then, should they not be as important to ours, especially now that the two are in competition?

Let us then produce cutting wines, but let them be well made and sound. By such wines the Italian wine trade will be benefited as much as is the French now.

II.

TASTING.

The word "tasting" is not used with its ordinary signification when referring to wine, but means, in that case, not only the testing of its flavor by means of the gustatory organs, but also a careful examination of the wine in other ways; of its appearance, of its bouquet, as well as of its effect upon the palate; all of which is necessary before a final judgment can be passed on its character, its qualities, and its defects.

Wine tasting is a somewhat difficult art, which cannot be acquired without long practice, and then only by one who possesses a clear eye and very delicate organs of taste and smell. When the last two organs have the requisite sensibility, practice alone is necessary to give them the skill needed in tasting a wine.

It is by frequent tasting, by making comparisons, by the examination of good types, that this delicacy and sensibility of the palate is developed which enables it to detect and appreciate the faintest aroma, flavor, or bouquet, as well as the slightest defect.

Practically the tasting of a wine is, up to a certain point, of more importance than its chemical analysis. Analysis shows us the principal components of the wine and the proportions in which they are combined; tasting tells us whether these components are in proper proportions to form an harmonious whole, or are, some of them, in excessive or deficient amounts; whether the wine has "sève," bouquet, aroma; whether it is mature or not; whether it should be racked or bottled; what its defects are, its keeping qualities, etc.

Any one can say whether a wine pleases him or not, but only the experienced taster can pronounce with any degree of certainty on the real properties and character of a wine. A good wine may be pleasing to-day and not so to-morrow, on account of slight exterior influences which are dangerous to its stability but may be only transitory in their effects, and the wine may recover and be as good as ever.

In order to make useful deductions it is of the highest importance, in fact absolutely necessary, to be able to appreciate and reflect on the sensations experienced in the tasting. It is not every one who can appreciate the true import of what they perceive, but only those who have trained themselves by long practice.

The experienced taster, when called upon to give his opinion, looks at and attentively examines the wine. He then agitates it by shaking the glass, and, when necessary, places his hand round the glass in such a way as to warm the wine, thus favoring the volatilization of those matters which affect the olfactory organs; he then tastes it.

Sometimes the simple agitation of the wine by twirling the glass is not sufficient, especially when the sparkling and bouquet are to be particularly noticed. In this case the wine must be more thoroughly shaken, which is done by placing the palm of the left hand over the mouth of the glass, and then striking the bottom of it forcibly against the knee. This causes the wine to give off its odors, and in the case of sparkling wines its carbonic acid, more freely. The method, writes Ottavi, is not very polished or elegant, but accomplishes the purpose very well.

As can be easily seen the wine taster should preserve his senses, that is, those of smell and taste, with their utmost sensibility; this is only done by avoiding excesses of all kinds, for these in course of time are bound to diminish that sensibility, or to destroy it completely. Thus he must abstain from all highly alcoholic beverages, from strongly salted or flavored dishes, from tobacco in any form, and in general from everything that acts too energetically on the organs of the abovementioned senses.

Physical indisposition, more especially affections of the nasal organs, the mouth, or throat, diminish or destroy all sensibility of the senses of taste and smell.

"Wine should not be tasted fasting, or it will taste weak and insipid; nor after drinking wine; nor with a full stomach. Moreover, the taster should not have eaten anything sour, salt, or bitter, nor anything which might change his taste; but he should have eaten a little, but not yet have digested it."—Carlo Stefano.

The taster should not attempt to give his opinion of more than a certain number of wines at a time, as after having tasted a certain number the senses become temporarily much impaired and incapable of nice discrimination; nor should he judge of a wine after an abundant repast, as the various flavors of highly seasoned or sweetened foods have a great influence on the palate, and prevent it from judging a wine critically.

It is a well-known fact that after eating sweet fruit a wine seems to be rougher and harsher than it really is, whilst cheese, nuts, artichokes, etc., make it appear smoother and more delicate.

With piquant cheese, like Parmigiano and Roquefort more especially, which Grimod de la Reynière has called "the tippler's biscuit," all wines seem good, or at least much better than they really are. It is also true that strong and badly tasting wines when drunk undiluted destroy the sensibility of the palate; people habituated to these wines end by being unable to find any taste in the fine wines of delicate flavor which are the delight of the connoisseur.

Tasters who are accustomed only to high-class wines, when they taste ordinary or low-class wines are apt to underrate them, if they do not reject them as altogether valueless, though they may be sound and clean tasting.

On the other hand, tasters accustomed to ordinary wines almost always deem the prices paid for high-class wines excessive.

This suggests the importance of habit as a factor in the modifications which the taste may undergo. It may easily happen that the prolonged use of a substance may render the sense of taste obtuse, and that the tongue may become "saturated," as Brillat-Savarin says in one of his happy aphorisms. Thus, when the palate has become habituated to a taste, that which at first was intolerable becomes often pleasing and even necessary. Generally, however, habit educates the sense of taste and renders it acute.

Sometimes a taster is called upon to give an opinion as to the character, the good or bad qualities of a wine of a certain locality or of some particular producer or vineyard; in this case, even though he may be well acquainted with the kind of wine, to be able to give his decision with more confidence, he will carefully provide himself with a wine of the same type as that which he is called upon to judge; he can thus receive material aid by making a comparison.

Naturally, a taster who is used to the wines of a certain locality or country will be more easily able to detect the slightest differences between the wines of that locality, especially those differences in fine wines which distinguish wines produced by different vineyards even in the same locality, and when planted with the same varieties of grapes.

A taster should be very cautious in giving an opinion of a young wine, or of one whose origin is unknown, and of pronouncing on its intrinsic worth; the youth of the wine will often mask defects, which, later, become apparent.

When it is found necessary to taste several wines in succession, it is a good practice to eat a little dry bread between each wine, or to rinse out the mouth with a little fresh water, to neutralize the palate, so to speak.

It is always good to rinse out the mouth with fresh water before commencing to taste.

Before commencing the tasting, or rather the final tasting—that on which is based the concluding judgment—the wines should be sorted; for example, if the wines are of the same kind, but of different ages, it is best to begin by tasting the weakest, thinnest, or greenest wines, reserving the maturer wines and those which are more aromatic, smooth, or alcoholic for the last.

The same is true when there are many and diverse wines, as at an exposition. In this case the tasting proper should be preceded by an arranging of the various wines, a thing which is not done at all, or badly done as a rule, much to the detriment of the exhibitors. This selection should be based not on the labels on the bottles, or on the statements of the exhibitors, but on a preliminary tasting; in this way those who are to judge the wines will not be presented successively with different types of wine, with wines of different qualities and ages together, and, as is unfortunately the case, sometimes with defective or bad ones.

There are tasters who are ready at any time to pass judgment on a wine; they will even taste directly after smoking. Their opinion, to say the least, is of little value.

A good taster is not always in condition to exercise his art, and for that reason must sometimes refuse to make a tasting when he does not feel in a state to judge critically.

Here I may appropriately remark that the wine dealer often relies too much on the lack of delicacy of taste on the part of the consumer. He should remember that among his customers there is occasionally a connoisseur, or at least a fairly good taster, who can appreciate the wine at its true worth, and whose opinion is followed by the majority of his other customers.

A little advice is needed also by those who are called upon to judge competing wines at exhibitions or elsewhere.

Without exaggeration, I may say that there is scarcely a person in

Italy, connected in any way with wine, who has not been called upon to act as judge in competitions of this kind. I need not say how much harm this has done our national wine industry; I will simply, with Polacci, express the desire that we might see some day in Italy "una vera magistratura enologica," a body of competent men to look after these affairs.

We will now return to our tasting. The forenoon is the time best adapted for wine tasting; the wines are of the proper temperature, a temperature which varies for red wines between 54° and 60° F., and for white wines between 50° and 54° F.; the taster is in good condition, and consequently the tasting may begin.

There should be no bad odors present, and the place in which the tasting* takes place should be well lighted with diffused light, not obscurely through a small and narrow window, nor too brightly by the direct rays of the sun; it should be remote from all noise, where the taster can remain quite undisturbed.

It is a fact admitted by physiologists that the senses exercise a mutual influence on one another, so that anything that excites one sense has the effect of increasing the acuteness of the other.

This reciprocal influence seems to be confirmed by the recent researches of Dr. Albertini, who says that the defect of color-blindness is accompanied by a corresponding deafness for certain sounds. Thus, those who cannot perceive red cannot distinguish *sol*, while those who are color-blind for green are unable to recognize *re;* to this lack of oral perception is joined the inability to reproduce these notes with the vocal organs.

"The taster," writes Franck, "should be deaf and dumb; deaf, in order that his judgment of the various qualities and defects revealed to him by his senses may be undisturbed; dumb, in order to prevent the expression of a hasty or insufficiently considered opinion."

Every one has noticed how a gourmand will close his eyes in order better to appreciate the delicate flavors of a substance, thus bringing his mind to a proper state of attention by the absence of all other excitement. This will explain the exclamation of the court parasite, who, disgusted with his too turbulent table companions, cried: "Hush! You do not understand what you are eating."

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* Here the question asked in "Conseils d'un amateur:" How should wine be drunk? might appropriately be answered. In our opinion, in order that the benefits of drinking it may be enjoyed in their fullness, the first thing necessary is that the wine shall be presented in the manner most pleasing to the eye and to the palate, for this impression on the senses has a most important influence on the rest of our body. With this end in view we should be scrupulously careful to have the wine at the exact degree of temperature that the nature and quality of the wine demand for the proper development of its flavor and bouquet, and then to make a judicious choice of the kind of glasses in which it is to be served. For Bordeaux, Burgundy, Chianti, Barolo, etc., the proper temperature is that of the dining-room, where they should be placed for some hours before they are to be consumed. White wines, sweet wines, etc., must be of the temperature of the cellar, that is, supposing the cellar is very cool, otherwise it is necessary to cool the wine, either by placing the bottles *on* ice, or by placing them in water containing a few lumps of ice, but never *in* the ice, for that completely destroys the character of the wine. Champagne is the only wine that may be put in ice, but even in this case discretion should be used, and if the wine is put in ice for three or four hours before being used it will be found sufficient, and the wine should then be served directly from the bottle. It is then a great mistake to place wine in ice or in freezing mixtures, for a wine so treated destroys the appetite and is injurious to the health.

The practice of pouring champagne into decanters containing ice cannot be too strongly deprecated. In the first place, it is not wine you drink, but a mixture of champagne and water; and secondly, the temperature is never right, as it cannot be regulated.

Let us add that ice should never be put *into* wine, for it destroys the bouquet and flavor of the wine, and if it gives a momentary pleasure to the palate by a sense of coolness, it also renders the digestion slow and laborious.

The taster should be provided with a porcelain cup, or with the Bordelais silver cup, which, however, may be made smooth, and if so, the bottom should be a little raised; this cup is especially applicable to young or blending wines, as it is the best for observing the tint and intensity of color and the degree of limpidity.

There are two kinds of Bordelais cups; one preferred by the sellers, and the other by the buyers.

Naturally the seller tries to show off his wine to the best advantage; for this purpose he prefers a cup with a raised bottom, bright, shining hollows in the sides, and a large rim, on which the rays of light have a pleasing effect.

The high rim and the yellowish tint that the maker gives to the silver of the cup concur to improve the appearance of the wine. The buyer's cup, on the contrary, is of silver of its natural color, and without the exaggerated rim, and without anything that might modify the appearance of the product to be examined.

In Bordeaux they prefer a cup almost without border, a kind of plain saucer, having in the center a slight convexity. In this cup the wine appears exactly as it is, without the slightest artificial alteration.

Lately the buyers of the Gironde have begun to use the twin cup—that is, two cups joined together with a hinge—by means of which it is possible to have two wines, which it is desired to compare, in almost the same conditions with regard to light.

Besides the Bordelais cup he should have at his disposal glasses of various forms, but all thin and homogeneous. Some should be chalice-shaped, but not too long; some of the shape known as "Bordelais;" some cognac glasses, narrow at the mouth and widening below, that is, truncate egg-shaped. By means of the latter, the bouquet, fragrance, and odors generally can be best perceived, especially when their disengagement is aided by shaking.

Conical glasses, on account of their form, serve very well to judge of the color of a wine, as according to the height in the glass where the wine is examined, there will be a greater or less thickness for the rays of light to traverse. Between the two extremes the differences of tint (the gamut of color going from rose to red in the case of red wines, and from white to golden in the case of white wines) is very interesting, and may sometimes give very useful hints.

The different aspects under which a wine can be considered are so numerous, there is such an almost infinite number of possible differences in the various qualities and defects that have to be considered, that even the most expert taster would find himself in great perplexity without a proper and systematic arrangement of his sensations. To avoid this perplexity he proceeds as follows:

He takes a glass containing a small quantity of the wine; raises it to a level with his eyes, examining it carefully first at arm's length, and afterwards more closely; raises and lowers the glass in order to view the wine from above and from below. By inclining the glass and viewing it in different positions, by giving the wine a rotary motion, making it rise up the sides of the glass, he is assisted in his observations. In this way the taster learns all that can be discerned by the organ of sight, namely: the color or colors, the degree of limpidity, the disengagement of bubbles of gas, and the degree of persistence with which they cling to the sides of the glass.

Its appearance is, to a certain point, a sign of the condition of th wine; from it the taster receives his first impressions and begins to form his opinion; this opinion is as yet, however, very relative, and rests only on probabilities, as a good wine may possibly wear the aspect of a bad one.

"Limpidity and vivid color are favorable signs," writes Guyot, "but they do not constitute high quality, though the contrary appearances are real defects."

Thus, though the eye may be pleased, the nose and palate may not be.

The experienced taster will be able to tell, to a certain extent, whether the color is natural and homogeneous, and so to a certain extent whether it is artificial; in this latter case he will be able to make a probable guess at the nature, vegetable or mineral, of the substances used to give color to, or to enhance the color of, the wine.

The estimation of the color of wine is very important, especially with cutting wines which are to be mixed with others to obtain the type demanded by customers.

The eye having fulfilled its office, it is the turn of the olfactory organs.

The sense of smell resides in the ample nasal cavities, and more especially in the pituitary, the mucous membrane which lines them. Odors, or better, infinitesimal particles of substance, reach this membrane by means of the external organs of the olfactory apparatus, that is, by the nostrils; they may also enter by the internal nostrils, the two openings which put the nasal cavities in communication with the larynx.

Physiologists admit that the sense of smell is not provoked only during inspiration but also during expiration, though in the latter case much more weakly. Thus, Franck tells us that it is during expiration that we analyze the perfumes of wines.

Besides the expiratory movements that we execute, sometimes quickly and intermittently, sometimes slowly, in order to place fresh portions of air in contact with the mucous membrane, the cavities formed by the folds of the mucous membrane are of great aid in the perception of odors, as the air laden with odorous particles accumulates in them, and thus prolongs the impression. The mucous membrane may be more or less sensitive according to its relative state of dryness or humidity, which, as I have shown, are much affected by colds in the head. When too dry the cellules are almost indurated, and when too moist they are separated from the air by a watery layer which prevents their regular action.

As may be supposed from the foregoing, the sense of smell will receive two impressions, or rather, will receive impressions at two different times, the first before the wine is tasted, and the second when the tongue and palate have almost finished their action; that is, when the taster commences to swallow the wine.

The sensations received the second time are various and very different from those received at first.

The first sensations are those caused by the readily volatile substances that the wine contains, and which are given off at the ordinary temperature of the wine, and without other assistance than the shaking and motion given to it by the hand of the taster.

The second series, which is perceived during or after swallowing the wine, is caused by the substances which are volatilized by the increased temperature due to the heat of the mouth and to the wine being well "subdivided" by the tongue, and finally to the action of the juices secreted by the various parts of the mouth.

The taster having thoroughly examined the appearance of the wine, lifts the glass to a convenient distance and inhales the odors which are given off, and which fill the upper part of the glass, sometimes shaking or striking the glass to aid their giving off.

A wine may give off various odors, good or bad. I will treat of both of these when I come to describe the qualities good and bad which a wine may present.

Before proceeding further with the tasting it will be interesting to repeat the observations of Guyot, and of Brillat-Savarin, the "modern epicure," regarding the colors and aromas of wines.

"The aroma, like the color," writes Guyot, "is a favorable or an unfavorable, an agreeable or a disagreeable sign; but wine is above all an alimentary beverage; it is well that sight and smell should be satisfied, but it would be puerile and ridiculous to give undue importance to the satisfaction of these two senses, and to found the pretensions of a wine to superiority exclusively on its pleasing effect on one or both of them.

"I make this remark expressly because there are many hosts who have a troublesome habit of insisting that their guests shall continually inhale the odors given off by their wine, and especially insist on their smelling their empty glasses during a great part of the dinner, at the risk of making them die of thirst.*

"The connoisseur, like the taster, knows perfectly well the importance of the color and bouquet of a wine, but he knows also that their appreciation should be immediately followed by the introduction of the liquid into the anterior portion of the mouth.

"The color and the bouquet are two introductory notes of a gastronomic theme. Alone they have but a relative value, and give but a partial impression of the whole theme."

Brillat-Savarin, who is an authority in matters of taste, writes, in his "Physiologie du Goût:"

"For my part I am not only persuaded that without the sense of smell there is no complete tasting, but I am tempted to believe that taste and smell constitute but one sense, of which the mouth is the laboratory and the nose the chimney; or to speak more literally, of which the former serves to taste the tangible parts and the latter the gaseous."

Thus, for example, when we eat a peach, the first thing that strikes us is its perfume; when we place it in the mouth we experience a sensation of coolness and acidity which invites us to continue; but it is only when the mouthful is swallowed, when it passes beneath the nasal cavities, that we perceive the perfume, and the peach completes the impression that it should produce. This will explain why the sensations which are usually accredited to the sense of taste are in reality much more complicated than is supposed, and that touch and smell contribute in great part to the complex effect. It may be said that without smell taste would be reduced to very little and its agreeable sensations much enfeebled. Taste and smell combine with and complete each other, and Thomson has very justly defined them as the instruments of a unique sense. It is a well-known fact that if the nose be held whilst tasting a substance we perceive the fundamental tastes, such as sweetness, bitterness, salt, and acid, but all the delicate flavors disappear completely.

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*Here Guyot might safely add that these people who are so troublesomely importunate are generally those who have recourse to the addition of artificial aromas to their wines.

We have now arrived at the sense of taste, or, as some call it, the tasting proper. The sense of taste, with its somewhat complicated apparatus, is the one which has the most important office to fulfill; by it we decide whether the wine has the freshness, solidity, strength, delicacy, etc., in short, the qualities required by the most critical taster.

The principal seat of the sense of taste is the tongue, although it seems to have been proved that both the anterior face of the membrane of the palate and the posterior part of the palate are capable of receiving gustatory impressions.

According to the illustrious Professor Lussana, the tip of the tongue is distinguished by its ability to detect the finest gradations of flavor, whilst the posterior part, on the other hand, is distinguished by the intensity of its sensations, and is therefore more impressed by repugnant flavors.

Different parts of the organs of taste receive different impressions from the same sapid substance.

The action of sapid substances in contact with the tasting apparatus is somewhat complex, and is physico-chemical rather than mechanical, as formerly supposed.

For this reason the particular gustatory sensation due to any alimentary substance is felt more keenly when the substance is kept for some time in contact with the tasting membranes, as is the case, for instance, in slow mastication.

This time, however, should not be too much prolonged in tasting wine, or it becomes impossible to distinguish between the many and diverse flavors which a wine presents.

The taster, having now critically examined the wine to the best of his ability, by means of the eye and the exterior part of the organ of smell, must pass quickly to the domain of the sense of taste.

To this end, he slightly lowers his head, carries the glass to his lips, and introduces a sip of the wine into the anterior part of his mouth, where the sense of taste receives its first impressions.

The taster retains the wine in this part of the mouth for a certain time; and in order better to perceive the various flavors that affect this part of the tasting apparatus, he divides and subdivides the wine with the tip of his tongue, or as experts express it, he "breaks up" the wine, in order to increase the surface of contact between the wine and the gums, palate, and tip of the tongue.

As soon as the taster has received a distinct impression of all the sensations caused by the wine in this part of the mouth—that is, of those due to sugar, acid, tannin, etc.—he slowly raises his head, thus allowing the wine to pass to the posterior part of the mouth, when he takes a short breath and slightly gargles; at this stage of the operation he will perceive any earthy, bitter, or mawkish taste, or any taste of wood, cork, etc., that the wine may have; here he will also remark the alcoholic strength or weakness of the wine. The wine is then, so to speak, left to itself and passes into the larynx, the œsophagus, and on into the stomach.

As the wine passes down the throat it gives off odors which, as has been mentioned, ascend to the palate and the internal nasal ducts. The effect of these odors, and therefore of the qualities and defects of the wine, is intensified if the moment the wine is swallowed the mouth is moved as though masticating something.

It has been attempted to measure the duration of certain sensations; *i. e.*, those due to the aromas, bouquets, flavors, alcoholic strength, and the various tastes of wine.

In general these sensations are perceived in the brief space of time of 3 seconds, and their duration varies from 10 to 20 seconds. After the wine has been swallowed all the sensations disappear in about 7 or 8 seconds. In certain special cases the aromas leave a more lasting impression; bad tastes persist longer than good ones. In some wines the aromà can be perceived for 55 or 60 seconds.

The sensation due to astringency is of short duration in fine wines, and is much less intense than in the case of wines made from immature grapes, where it makes a violent impression on the lips and the sides of the mouth, which lasts sometimes for 100 to 110 seconds.

Different bad tastes have different ways of showing themselves; some are noticeable the moment the wine enters the mouth, while others are not perceived till some seconds after the wine is swallowed.

Some moldy tastes do not manifest themselves for 7 or 8 seconds after the wine has left the mouth, but persist for 100 or 140 seconds.

The "goût de rance" is perceived in from 10 to 15 seconds, and lasts for 50 or 60 seconds. The bitterness of some wines makes itself felt in 4 or 5 seconds, and persists for as much as 280 seconds.

In tasting, it should be kept in mind that certain qualities are liable to variations, according to the condition and age of the wine. The delicacy of a wine, for example, is almost totally hidden when the wine is young; the more so the younger the wine. This is due to certain substances which are proper to new wines, but which, later, are deposited and disappear from the composition of the wine.

Aromas are more or less intense, according to their origin and to the very variable circumstances under which they are formed.

The sense of taste is the final judge, and from its sentence there is no appeal. But how much careful consideration should be used before this judgment is pronounced; what a multitude of sensations must be considered, on all of which this judgment must be based!

The tongue, the cheeks, the gums, the anterior and posterior palates, the larynx, the nasal cavities, and to a certain extent the stomach, all contribute their separate sensations, which must all be taken into account. Besides these, the taster has also the sensations received by the eye and the nose. With all this varied testimony to consider, he should reflect deeply before delivering his verdict. For this reason, the taster, during the tasting and the few moments following, truly solemn moments, should be completely undisturbed by noise or otherwise.

A taster can sometimes conveniently express his verdict of quality by means of numbers; usually those from 1 to 10 are used, and correspond to the following expressions:

10—Perfect.
9—Almost perfect.
8—Quite good.
7—Relatively good.
6—Fair; sound, but not harmonious.

From 5 to 0 indicate various defects, according to their gravity.

III.

QUALITIES AND DEFECTS OF WINES.

The art of wine tasting, like every art or science, has a language of its own, without which the taster could not properly express his criticisms, nor compare his opinions with those of other tasters regarding the same wine.

This renders it necessary to define or explain the various terms that have been adopted by tasters to express the sensations experienced by their senses of sight, smell, and taste, during the examination of a wine.

FOAM (*Spuma*, It.; *Mousse*, Fr.).—When a wine is poured from one vessel to another, or agitated in any way, there forms a more or less abundant foam; that is, at the surface of the wine there are formed in greater or less quantities collections of little gaseous bubbles.

FINE FOAM (*Spuma di grana fine*, It.; *Mousse à perles fines*, Fr.).—The foam due to the formation of very small bubbles.

COARSE FOAM (*Spuma di grana grossa*, It.; *Mousse à grosses perles*, Fr.).—When the bubbles are larger.

EVANESCENT FOAM (*Spuma evanescente*, It.; *Mousse évanouissante*, Fr.).—Said of that which disappears immediately, or almost as soon as formed. As the old saying has it: "*Vino che brucia la spuma*" (a wine that consumes its foam).

PERSISTENT FOAM (*Spuma persistente*, It.; *Mousse persistante*, Fr.).—When the foam lasts some time and disappears slowly.

Persistent foam, as a rule, is characteristic of a wine poor in alcohol; of a wine at a low temperature, or of a wine in need of racking, or, it may be, of a wine which is undergoing a slow fermentation, which may be either the normal and necessary alcoholic fermentation, or may be what is known as a secondary fermentation, in which case the wine is a prey to some malady—tartaric fermentation, for example.

The foam may also be persistent on account of effervescence, that is, the continued giving off of carbonic acid, which is dissolved in the wine, and which in escaping on the decrease of pressure forms little bubbles which renew the foam.

In the first cases cited above, the foam is usually limited to a more or less imperfect crown or ring of bubbles which form around the edge of the glass; or if the wine contains more than the usual amount of carbonic acid a bubble of gas will now and then be formed and rise to the surface.

When some disease is the cause of the persistent foam, especially if it be that known as "*subbollimento, cercone, or vino girato*" (*vin tourné* of the French), the circle formed is called "*unghia*" (nail), from which the expression "*il vino fa l'unghia nel bicchiere.*" [This disease of *turned* wine is due to the filiform ferment, which destroys the tartar of the wine.—*Trans.*]

In the last case, when the persistent foam is due to effervescence, which may be of various intensities, several distinctions are made, of which the following are the principal:

SHARP, PUNGENT (*Frizzante, Piccante, Wine which has the Pinzo*, It.; *Mordant, Piquant*, Fr.).—In this case there is a somewhat abundant giving off of bubbles of carbonic acid when the wine is agitated, and even after, which tend to cling to the sides of the glass. Some one has written of a wine of this kind that "*nel berlo baciá e mordé*" (it kisses and bites); it makes itself felt as a smarting or pricking on the palate.

> "*Sarà forse più frizzante*
> *Più razente e più piccante.*"—Redi.

This pricking is caused by the presence of a larger amount of carbonic acid than is normal to the temperature and pressure.

The Tuscan usage of "governo" imparts this character to a wine.

"When the violent fermentation is over, throw in two handfuls of dried grapes to each vat; this will make the wine clearer and more piquant."—Davanzati.

However, Polacci rightly says: "For us a wine *governato* is always a defective wine."

FOAMING (*Spumeggiante*, It.; *Écumant*, Fr.).—This is said of wines which contain so much gas that when they are agitated bubbles are given off copiously, enough to form a layer of foam over the whole surface of the liquid. In the words of Redi:

> "*Che nei vetri zampilla,*
> *Salta, spumeggia, e brilla.*"

Wines which are bottled young, before they are well defecated, or which contain sugar when bottled, easily become "*spumeggiante*" when kept in a cool place.

SPARKLING (*Spumante, Mussante*, It.; *Mousseux*, Fr.).—This is said of wines which, after pouring into a glass, give off from every part an abundant supply of bubbles of carbonic acid, or foam, which collects at the surface and is continuously renewed for some time. The wine bubbles, and as is commonly said, pearls the surface.

In sparkling wines, the carbonic acid is in solution at a relatively high pressure.

In these wines, after the first violent ebullition of gas, there is what is known as the "*fontanella*," sparkling, which is due to a continuous development of very small bubbles of gas, which, starting from certain points at the sides or bottom of the glass, rise like little chains of beads to the surface, where they cause the phenomenon known as pearling.

Of sparkling wines there are three grades, based upon the amount of foaming, or rather on the amount of carbonic acid which is given off, and on the length of time during which the foaming continues.* These grades are:

CREAMING, GENTLY SPARKLING (*Mezzo spumante*, It.; *Crèmant*, Fr.).—These are wines in which only a slight layer of foam forms, and which give off but a moderate amount of gas; that is, effervesce very slightly.

The pressure exerted by these wines on the interior of the bottles is less than three atmospheres.

ORDINARY SPARKLING, OR MEDIUM PRESSURE (*Spumante, bella spuma*, It.; *Mousseux ordinaires*, Fr.).—In these wines there is sufficient gas to cause the foam to flow from the bottle the moment it is uncorked. The pressure in this case varies from three to three and one half atmospheres.

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*The French have a fourth grade, which they call Tissane, and which includes second and third-rate wines, which are, however, fairly drinkable.

Strongly Effervescent (*Molto spumante*, *Spuma forte*, It.; *Grand mousseux*, Fr.).—In these the cork is forcibly ejected from the bottle when unwired, and the wine is sufficiently charged with gas to be expelled from the bottle by its own pressure.

In these wines the pressure approaches or surpasses four atmospheres. The maximum pressure that bottles will stand, without great danger, is about six atmospheres.[*]

Either too low or too high a pressure is a serious defect in sparkling wines. If the pressure is too low they do not effervesce; if, on the other hand, the pressure is too great, as in the case of bottles which the French call "recouleuses," there is a ruinous percentage of broken bottles, or if the bottles do not burst the cork is driven out, and most of the wine lost.

The carbonic acid which is dissolved in these wines, is produced by the fermentation of added sugar, or of a portion of that which the must contained.

As already stated, wines which have been fermented dry, and not with a view of making them sparkling, can be rendered so afterwards by being charged, at a high pressure and low temperature, with carbonic acid. On this is based the system of Carpené, a system now much used both in Italy and abroad.

Sparkling wines may be:

Sweet (*Dolci*, It.; *Doux*, Fr.).—When the sweetness is decided and due to a large addition of syrup.

Dry (very slightly sweet) (*Semidolci*, *Dolcigni*, It.; *Douceâtres*, Fr.).—When the sweetness is slight or hardly noticeable.

Extra Dry (*Secchi*, *Asciutti*, It.; *Secs*, Fr.).—Which the English taste calls for; when there is no trace of a taste of sweetness.

In various red wines the foam may present different colors, as:

White (*Bianca*, It.; *Blanche*, Fr.).—The case usually with old wines. There are, also, in some localities, young red wines of which the foam is white or whitish.

Rose (*Rosea*, It.; *Rosée*, Fr.).—This is the case with lightly colored young wines, and is characteristic, it may be said, of mature wines.

Red, Ruby (*Rossa*, *Rossa rubino*, *Vermiglia*, It.; *Rouge*, *Vermeille*, Fr.). The color of the foam of heavy-bodied, deeply colored young wines.

Orange Red (*Rossa granato*, It.; *Rouge grenat*, Fr.).—This is a deep vinous red, resembling the color of pomegranates, and is often seen in cutting wines, or those blended with them.

Bluish (*Turchiniccia*, *Bleuastra*, It.; *Bleuâtre*, Fr.).—Seen in wines poor in acid; as in some cutting wines which possess only from 3 to 4 per cent in acid.

Bright, Clear (*Viva*, *Brillante*, *Smagliante*, It.; *Vive*, *Brillante*, Fr.). When the foam has a clear, crystalline appearance; this is generally seen in generous, young wines of full acidity.

Dull, Dead (*Poco viva*, *Morta*, It.; *Morte*, Fr.).—The opposite of the foregoing; indicates a diseased or decrepit wine, or one in need of racking.

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[*] As a rule, authors give higher figures for the pressure of the various kinds of champagne than I have indicated, but the fact is, that my figures, if not too low, are certainly not too high. Of this, I am assured by Professor Carpené, who, in his experiments with sparkling wines, had occasion to test the pressures of many wines from the best accredited foreign and domestic houses.

After the foam is disposed of, the taster remarks on the degree of limpidity which the wine presents; a wine is said to be:

CLEAR (*Limpido*, It.; *Limpide*, Fr.).—When it is transparent and without cloudiness; or what Columella calls "*vinum defaecatum quam limpidissimum.*"

BRIGHT, BRILLIANT (*Brillante, Diafano, Lucido, Smagliante*, It.; *Brillant, Lucide, Luisant*, Fr.).—These terms are used to express a perfect and, as it were, crystalline transparency. This is the condition of wines that have been well clarified or filtered.

It may be noted here that clarification, unlike filtration, slightly modifies the composition of wine, as is proved by the quantitative determination of Professor Carpené, relative to wines that had been treated with white of egg. Following are the results of these determinations:

	Tannin.	Œnocyanin.	Extractive Subtances.	Ash.
Wine of 1873, unclarified	0.91	0.42	21.39	3.12
Wine of 1873, clarified	0.41	0.24	19.91	3.06
Wine of 1874, unclarified	1.15	0.82	24.22	2.80
Wine of 1874, clarified	0.57	0.44	20.17	2.79

The quantity of albumen employed was about 100 c.c. per hectolitre (1 per m., or 1 pint to 125 gallons), which is a usual dose.

CLOUDY, DULL (*Vellato, Appannato*, It.; *Voilé*, Fr.).—This is said of wines that are not quite clear, that show a slight cloud or dimness, due to the presence in them of substances in suspense in a very fine state of subdivision. This is noticed, for example, in wines recently racked, especially when, during the operation, they have been much exposed to the air and drawn into well-sulphured barrels.

This slight defect, which is easily cured, is also frequently found in wines made from grapes grown on rich soil, and also in wines which, being poor in acid, have not undergone a complete fermentation.

Wines, of course, may possess different degrees of cloudiness, which are generally expressed by the terms cloudy, slightly cloudy, nearly clear, etc.

TURBID, MURKY, THICK (*Torbido*, It.; *Trouble, Cassé*, Fr.).—When the suspended particles are large enough to be almost visible to the naked eye, and present in sufficient quantity to completely destroy the transparency of the wine and make it almost opaque.*

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* Old bottled wines may be turbid either because they have become unsound, as happens very easily when bottled too young, or because they have not been thoroughly defecated before being bottled, or it may be, because they have been moved in such a manner as to stir up the slight deposit which all wines throw down in time in greater or less quantities. If the wine is unsound there is no need of precautions, for the wine has become undrinkable; if, on the contrary, the turbid wine is sound it must be moved with the greatest caution, and to prepare it for the table it will be found useful to follow the rules of C. Ladrey, who writes thus:

"When the time arrives to drink a wine which has lain in bottle for some years, the first thing to do is to examine the bottle with great care when it is lifted up. It should be lifted up cautiously, retaining it in its horizontal position. By carrying the wine into the light, daylight or artificial, it is easy to ascertain whether the wine is perfectly clear or has a deposit. If, as may happen, the wine be perfectly clear, without trace of deposit, the bottle may be stood up and the wine served from it without decantation. This case, however, is very rare, and, especially with old wines, there is generally a deposit.

A wine from low-land grapes, in which tartaric fermentation has reached the stage of development when carbonic acid begins to be freely given off, is a good example of this condition.

This defect may be simply transitory, as when a wine has lately received some treatment, or an addition of alcohol or tartaric acid, or directly after cutting or mixing wines, or when a wine has been much shaken or been exposed to too low a temperature. If the defect is permanent, it shows that the wine is diseased or ready to become so, or that the wine has been badly made. In the former cases the wine simply needs time to depose or an increase of temperature, when it will right itself. In the latter cases some special treatment is necessary, such as sulphuring, addition of tartaric acid, clarification, pasteurizing, etc.

Opalescent, Iridescent (*Cangiante*, *Opalescente*, *Iridiscente*, It.; *Chatoyant*, Fr.).—When the light in passing through the wine is decomposed, that is, when in looking through the wine rays of different colors are seen. This iridescence is best seen at the surface of the liquid and near where it is in contact with the glass; it is due, not to reflection or refraction, but to the phenomenon of interference.

A wine exhibiting this peculiarity is open to grave suspicion of unsoundness, if it is not already in an advanced stage of disease.

As an example of a wine in this condition, may be cited one which is, in the first phases of the disease, known as "subbollimento."[*] If a little of this wine is left exposed to the air it first becomes turbid, and loses its red color; then a precipitate forms and leaves a yellowish, sour, somewhat bitter liquid on top. As the disease progresses, if the wine is slightly shaken, mucous clouds will be seen floating in it, at the surfaces of which the above-mentioned phenomenon of interference may be seen.

In the time of Pliny, to describe the color of a wine they had only the four following epithets: *album*, *fulvum*, *sanguineum*, *nigrum*.

In those days they were easily satisfied; now we use the following terms to describe the colors of red and white wines:

Colorless, Decolorized (*Incolore*, *Scolorito*, *Decolorato*, It.; *Incolore*, *Decoloré*, Fr.).—When the wine has almost the appearance of pure water; when the rays of light pass through it without suffering any or only imperceptible changes.

Colorless wines are easily obtained from perfectly ripe white grapes, picked and handled with great care, and crushed when quite fresh and quite cool; then by exercising the most scrupulous cleanliness during the vinification and keeping of the wine, and by fermenting the must after it has been well defecated. If a wine is made which is not per-

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In this case we must be careful not to mix the limpid part of the wine with the deposit, and before raising the bottle up the wine should be decanted, which in its result is an operation exactly similar to racking. This decantation should be made in the cellar, and demands some precautions. First the neck of the bottle is carefully raised, but not too high; it is then uncorked, care being taken not to subject it to any brusque motion either in raising it or in drawing the cork. The wine is then poured into another perfectly clean bottle, taking care to stop before the smallest part of the deposit has passed into the fresh bottle or decanter. The quantity of wine lost by this method is very small, and the wine that is saved can be drunk to the last drop. If, on the contrary, a wine which has only a very slight deposit is placed on the table without decanting, the second or third glass will commence to show a loss of brightness and the wine will have lost its agreeableness. There are some very simple machines made, which work on the principle of the siphon, and which greatly facilitate the operation of decantation."

[*] "La pousse" of the French, a kind of tartaric fermentation which is fully described on a subsequent page.—*Trans.*

fectly colorless, it may be rendered so by the use of animal charcoal, properly prepared, that is to say, in such a way as to prevent its diminishing the acidity of the wine. If this precaution is not taken, the wine, on account of its diminished acidity, will quickly turn yellowish on account of the formation of ferric compounds, which, under these conditions, takes place with great readiness.

Straw-Colored (*Paglierino*, It.; *Couleur de paille*, Fr.).—Of the color of straw, but somewhat pale.

Amber, Yellow (*Giallo*, It.; *Jaune*, Fr.).—Is said of wines which have a deeper straw color.*

Golden, Golden-Yellow (*Giallo dorato, Aurato, Dorato*, It.; *Doré*, Fr.).—This epithet sufficiently explains itself.

"*Egli è il vero oro potabile*," wrote Redi of the wine of Trebbiano.

Greenish (*Verdognolo, Verdiccio*, It.; *Verdâtre*, Fr.).—When a wine has a slight greenish tint, resembling somewhat the green of grass. This color is characteristic of certain varieties of grapes; for example, the Verdea or Bergo.

Regarding the wine of this variety, it is said that the Verdea of Tuscany is not so called on account of its green taste, but because of its greenish tint.*

Frederick the Great, of Prussia, had a great predilection for the wine of Verdea.

This greenish color is also characteristic of the wines of Reno, and in general of wines made from somewhat acid grapes.

Pinkish-Yellow, or Pinkish Straw-Color (*Paglierino rossastro, Giallo rossastro*, It.; *Paille roussâtre*, Fr.).—Sometimes a wine, in addition to its yellow or straw color, will have a pinkish tint of more or less intensity. This may be considered as due to imperfect cleanliness of the vessels used in wine making, or of the barrels in which the wine has been put.

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* This yellow color may be natural and proper to the wine, or it may be a color which it has acquired from several causes, among which are some that have very grievous effects on the wine, and may be considered properly as maladies.

The wines most generally subject to this disease of becoming yellow are those poor in alcohol, tartar, tartaric acid, and tannin, and which on the other hand are rich in malic acid.

I have already alluded to one of these causes above, namely, the presence of iron compounds. Some colorless wines, which are rather poor in acid, become, when placed in contact with the air, yellow or yellowish brown, in consequence of the formation of complex compounds, ferric, humic, etc.

The commonest causes of the yellowing of wines can be traced to the conditions under which the vintage has taken place; if, for instance, the season has been cold and rainy, and the grapes have been gathered after the vines have in great part been denuded of their foliage, if the bunches contain decayed, soft, insipid grapes poor in acid and sugar, a wine of poor keeping qualities is obtained, and one very likely to become yellow, unless art comes to the aid of nature.

Robinet, who has made special investigations with regard to the causes of this deterioration of white wines, distinguishes between that due to a fermentation caused by a mycoderm, and those due to chemical action, and among the latter he mentions some which give rise to the formation of malic ether, which reacts on the sugar. I should, however, remark here that after stating his belief in the formation of the malic ether, he declares that he has been unable to find the rational equation of the reaction, or definite proof of its existence, but bases his belief in the formation of the malic ether on the taste and pronounced odor of cider which the wine acquires—an odor which is characteristic of the above substance.

Robinet also makes the important observation that during his researches he had noticed the disappearance of the glycerine from wines which were becoming yellow. This disappearance of the glycerine would lead one to believe that the reactions which take place are much more complicated than supposed by Robinet, especially in consideration of the fact that the glycerine is subject to transformations, like the other ingredients of wine.

Instead of trying to cure or ameliorate this defect in wines, it should be prevented, which can be done by the addition of alcohol and acids.

The secondary fermentation which causes this disease is due, still according to Robinet, to a particular mycoderm, which can be seen distinctly with a magnifying power of nine hundred diameters. This mycoderm is extremely small, and of an oblong shape; it is $\frac{1}{600}$ m.m. in length, and $\frac{1}{900}$ m.m. in width.

ROSE-COLORED, SHILLER (*Rosato*, It.; *Rosé*, Fr.).—White wines made from red grapes frequently possess this color in greater or less degree; especially is this the case when the grapes have not been picked and handled with great care, or when the grapes have become the least heated.

A white wine may also acquire this color by contact with barrels or utensils which have been used for red wine and not been thoroughly cleansed afterwards.

This color is sometimes produced artificially. In France they use extensively *teinte de Fismes*, so called after the town in which it is manufactured. It is claimed that it is free from alum and sulphuric acid,* but wrongly.

White wines which have commenced to spoil, or in which viscous fermentation has started, and which begin to become brownish, or even bluish, and at the same time turbid, what the French call *vin oeil de perdrix*, are rendered salable by the use of this *teinte de Fismes*, and are sold by the French under the name of *vins rosés*.

Jacquesson, *père*, states that this coloring fluid not only colors and clarifies the wine, but also arrests the progress of the disease, or prevents it if it is to be feared. This fluid is also used in France for coloring sparkling wines.

BLUISH-BROWN, BROWN-YELLOW (*Bruno-bleuastro*, *Giallo-bruno*, It.; *Brun-bleuâtre*, Fr.).—This color, which the French call *oeil de perdrix* (partridge-eye), is a dull, dark yellow, proper to some old, southern wines, but due in the majority of cases in which it is found to some malady of the wine. †

This phenomenon is observed not only in old but also in young wines, both red and white. Very probably its origin lies in several causes, as the numerous explications given by different authors would lead us to believe. Nessler has studied the change of color as it takes place in white wines. He tells us that the substances that cause the coloration, more or less deep, of the wine are contained in the stems and the seeds. Thus, wines which have been fermented in contact with the solid part of the grapes blacken very easily when exposed to the air. The presence of bad grapes in the fermentation also tends to render a wine liable to this discoloration.

This change of white wine depends directly on the action of the air;

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* The *vin*, or *teinte de Fismes*, was first prepared by Manceau by boiling elderberries and cream of tartar together.

† It sometimes happens, writes Robinet, that a perfectly bright white wine which has never been racked or otherwise treated before, is racked from its lees and treated with tannin and some clarifying material; then instead of becoming bright and clear the operations to which it has been treated have had diametrically the opposite effect. The wine has not taken the clarification, as the cellarmen say, has a bluish tint, and is turbid.

This change or malady of the "blue color" happens most generally in wines of low acid and alcoholic contents, and which are at the same time rich in nitrogenous substances. According to Robinet this malady is due to a secondary fermentation, caused by a mycoderm which is analogous to the *mycoderma crocceum*, and has a very ephemeral existence.

To cure this disease in a wine it generally suffices to raise the alcoholic strength, or sometimes an addition of six or eight grains of tannin per hectolitre is necessary. In the latter case the wine is allowed to settle for twenty-four hours after the addition of tannin, and then clarified with isinglass.

The above mycoderm is killed and precipitated by cold.

the wine loses its limpidity, becomes cloudy, and a black precipitate is formed; meanwhile the taste of the wine often changes. The black substance may be decolorized by sulphurous acid; the use of this substance arrests or retards the blackening of the wine.

Wines made from grapes poor in tartaric, malic acid, etc., like those which have been gathered when wet with dew or rain, or those which have been injured by cryptogams, are liable, when exposed to the air, to become cloudy and dark in color.

The presence of an excess of iron in the white wines of certain localities of the southern provinces is the reason why, when they are at all exposed to the air, their color changes to a blackish green.

Not southern wines alone, but also those from northern provinces, when they do not contain a sufficient quantity of acid, and more especially of tartaric acid, acquire this color. Chemists explain this phenomenon in different ways, though all admit that it is due to the presence of some of the compounds of iron. Nessler tells us that wines produced on soils rich in the salts of iron, and even wines which have been for any length of time in contact with iron, as happens when there is an iron rod between the heads of the cask, or when there are nails in the cask, etc., if they become exposed to the air, turn black, for then the protoxide or ferrous oxide contained in the wine changes in contact with the air to sesquioxide or ferric oxide. A black compound is then formed by the combination of the ferric oxide with the tannin; this black color is not obtained with the protoxide. Other chemists explain the phenomenon by supposing that there occur or are formed in the wine certain humic products analogous to those which are formed by the decomposition of vegetable substances. These substances are feebly acid, and have a considerable dissolving power on the iron. Thus there are formed in the wine certain of the lower compounds of iron, which, on exposure to the air, change to the higher compounds, and give the wine the blackish tint before spoken of. The wine then becomes turbid, and the flavor undergoes certain peculiar changes.

Formerly some sparkling wines were made of this color, but now it is no longer found but as a defect.

DIRTY (*Sporco*, It.; *Terne*, Fr.).—A diseased, badly made, or badly kept wine sometimes becomes turbid, and its natural color is masked by other colors, giving the impression of something soiled or dirty.

Among red wines the following are the colors most generally recognized; they may be of more or less intensity:

VERY LIGHT RED (*Claretto, Chiarello, Chiaretto*, It.; *Clairet*, Fr.).—These terms are used to describe a class of wines which contain the least color of any red wines; the cause of this poverty of color may be in the nature of the grape, the mode of preparation, or it may be that the wine has been diluted with water.

These wines form the connecting link between white and red wines.

Trinci, writing of these wines, says: "The French 'claretto' is a smooth, vinous, lightly colored wine, with little aroma; slow and long in maturing, and not pleasing when drunk alone; blended, however, in proper proportion, it is extremely good."

The "claretto" drunk by Redi, however, must have been very different from this, or he would not have written:

> "*Benedetto*
> *Quel claretto*
> *Che si spilla in Avignone.*"

RUBY (*Rubino*, It.; *Rubis*, Fr.).—Wines which have a fine, vinous red, which recalls the color of the ruby.

This color is that found most commonly in table wines; for instance, the wine of Chianti; it is also the color of the wines of Bordeaux.

Some writers speak of vermilion wines, but a wine is never really of that tint; wines rich in acid and of bright, intense ruby, will appear for the moment to be vermilion immediately after being racked, on account of the presence of a slight cloudiness.

PURPLE (*Porporino*, It.; *Pourpré*, Fr.).—The case where the natural red of wine tends slightly to violet.

This color is seen in Montepulciano when it has reached perfection.

GARNET, RED (*Granato*, *Rosso cupo*, It.; *Rouge sombre*, Fr.).—Said of wines which have a more or less intense blood-red, recalling the color of garnets and similar precious stones, and of some varieties of gooseberries, etc.

This garnet tint is seen in heavy-bodied dinner wines, such as Barbera, Gattinara, Borgogna, and in wines made from grapes grown on clayey and ferruginous soils. These wines in aging are apt to acquire more or less of the orange tint.

BLACK (*Nero*, It.; *Noir*, Fr.).—This color, the *nigrum* of the Romans, is really never found in wine; the darkest wines, made from the Teinturiers, are not quite black, nor is even the concentrated solution of œnocyanin obtained by the Carpené-Comboni process.

VIOLET, BLUISH (*Violaceo*, *Turchiniccio*, *Bleauastro*, It.; *Bleauâtre*, *Violacé*, Fr.).—This color is seen in a more or less marked degree in blending and other wines poor in acid. This tint is due to the violet coloring matter which is contained in certain dark wines of southern Italy. It is very unstable, and precipitates with great readiness. It is also found in the wines from certain American coloring grapes, such as the Jacquez, the Marion, and York's Madeira, when they have been made without addition of plaster or tartaric acid.

ORANGE, YELLOWISH-RED, RUSTY (*Aranciato*, *Giallo aranciato*, *Color matone*, *Rossico*, It.; *Orangé*, *Pelure d'oignon*, Fr.).—These are the colors or tints of old or decrepit wines. By decrepit wines should be understood wines which have passed their prime and have begun to lose their valuable qualities.

These tints are seen sometimes in young wines, but less marked than in old; especially in those which, at first, have much of the bluish tint, and which deposit their color quickly.

Old wines often lose all, or nearly all, of their color, and become what is called "scolorito," decolorized or faded.

DARK COLORED (*Colorato*, It.; *Coloré*, Fr.).—Said of wines that have relatively a great deal of color.

Wines may be divided according to intensity of color into deep-colored, medium-colored, and light-colored wines.

Deep-colored wines are harsh and indigestible.

I will now pass in review the qualities and defects of which the senses of taste and smell take cognizance.

AROMA (*Aroma*, It.; *Arôme*, Fr.).—By aroma must not be understood simply those odors which are delicate and agreeable, as when speaking of bouquet; for example, the foxy odor or aroma of certain American grapes, varieties of the species *Vitis labrusca,* and of the wine made from them, is far from agreeable.

The aroma is the odor which comes from the skins of aromatic grapes,[*] and varies in quantity and quality, according to the variety of grape and the degree of its maturity. It passes into the wine in wine making; the aroma therefore exists in the grapes as well as in the wine.

Bouquet[†] (*Profumo,* It.; *Bouquet,* Fr.).—Every fine wine exhales an odor peculiar to itself, which is always delicate and pleasing. Exception may be made of artificial bouquets, which, if not absolutely disagreeable in themselves, are always too strong and intense in a wine.

The bouquet is due to the volatilization at ordinary temperature of certain substances known as ethers, which are formed by the reactions of the acids and alcohols in the wine during its process of aging.[‡]

Thus, the bouquet is not to be found ready formed in the grape, as is the case of the aroma.

Sève (*Abboccato,* It.; *Sève,* Fr.; *Göhr,* Ger.).—The "sève" is neither bouquet nor aroma; it is a certain savor, a certain fragrant quality of the wine due to a smooth and delicate blending of perfections, of aromas and bouquets, which is perceived when the wine is in the mouth and in the act of swallowing, affecting the olfactory organs through the internal nasal ducts. The bouquet and aroma affect the senses before, the sève after drinking the wine.

Carpené, writing of Moscato de Segesta, says: "Of the most delicate fragrance and exquisite flavor. It is a dainty, fruity wine, which fills the mouth with an harmonious ensemble of delicious flavors, which cannot be described, but can only be experienced."

Sève, which is especially the property of fine wines, is due to the presence of certain substances which are formed in the grapes during the short time preceding their complete maturity; these substances are peculiar to certain varieties of grapes, and owe their existence also to careful cultivation, as well as to certain conditions of climate and soil.*

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[*] The ancients held aromatic wines in high estimation. They added to the must, during fermentation, different varieties of apples, then cane, amomum, cassia, saffron, ginger, and other species of aromas, to communicate the odor that they desired.

The aroma most highly appreciated was that obtained by the addition of myrrh. We read, in fact, in Pliny: *Lautissima apud priscos vina erant myrrhæ odore condita, ut adparet Plauti fabula, quae Persa iscribitur, quamquam in ea et calamos addi jubet.*

Peppered wine, which was prepared by fermenting the must with apples and pepper, was very much appreciated in the time of Pliny.

[†] Even the bouquet of wines has not escaped imitation and adulteration. The manufacture of artificial bouquets or perfumes for wines has become a regular industry in France and Germany, where it is carried on on a large scale. There is a large consumption of such articles as "bouquet" of Pomard, or of Bourgogne, extract of Bourdeaux, the "Rancio des vins," "sève" of Baumé, of Médoc, of St. Julien, of Champagne, of Sillery, etc.

The substances most usually employed to add an artificial bouquet to dinner wines, are: Florentine iris, raspberries, cloves, vine flowers, mignonette, nutmegs, bitter almonds, etc. To these should be added certain chemical products which are prepared more especially in Germany. All these attempts to imitate nature have been but very partially successful.

A wine may be perfumed artificially, but it is impossible to give it "sève." This artificial perfume is always too pronounced, and is never as delicate as the natural bouquet of wine. These artificial bouquets impress the sense of smell, but not that of taste. If a perfumed wine, then, is tasted without being smelled, its natural "sève" can be distinguished. Artificial aromas are not lasting, and gradually disappear from the wine.

[‡] Chemically, the difference between aroma and bouquet is, according to Maumené and Berthelot, the following:

The former is due to certain hydro-carbons and to the products of their oxidation; perhaps, also, as Ordonneau states, to the ether of a high, fatty acid produced by intercellular alcoholic fermentation, and which, being fixed, remains in the pellicle; this has enabled the experimenter to obtain it from the pomace of Folle Blanche.

The latter seems to be due to a mixture of aldehydes with one or more essential oils and of numerous ethers, the product of the combination of fatty and other polyatomic acids with ethylic and other alcohols; there are, for instance, valerian, amylic, propylacetic, etc.

In analyzing wine, writes Fauré, I have observed that fine and delicate wines, those renowned for their flavor and general high quality, contain a certain glutinous, viscid substance, which exists only in almost inappreciable quantities in ordinary wines, and is quite absent from inferior ones.

This principle, to which wine owes its sève, has been called by Fauré œnanthin,† or flower of wine, and is only found in grapes which are completely mature. Some vineyards, which usually produce grapes containing this substance, fail to do so in stormy seasons. The only vines containing it in such years are those produced on dry sandy or gravelly soils. The same variety of vines, which, when grown on an appropriate soil, gives a wine full of sève, will, when grown on a rich, heavy, or clayey one, produce a wine containing little or no œnanthin.

Thus it can be seen that the preëminence of high-class wines is not due to the caprice of the taster, but to actual differences of composition, and to the presence of principles not found in inferior wines.

The ordinary wines of the three communes of the Gironde, where the four high-class Bordeaux wines are produced, are, in general, poor in œnanthin. These four wines, however, contain a larger quantity of the substance, as may be seen by the following:

Œnanthin contained in vines of—

High Class.		Ordinary.	
Chateaux Margaux	1.25	Margaux	0.70
Chateau Lafite	1.20	Pauillac	0.75
Chateau Latour	1.10	Pessac	0.50
Haut-Brion	.65		

FLAVOR (*Sapore*, It.; *Saveur*, Fr.).—In this character we have the effect of the wine on the sense of taste, and more particularly on the tongue, which best distinguishes between various tastes. The flavor is distinct from either aroma, bouquet, or "sève"; unlike the last, it does not affect the sense of smell. As has been shown, the sève is perceived after the wine has passed the base of the tongue, the soft palate; the taste, on the contrary, or better, the flavors, are perceived almost immediately, and continue to affect the tongue and its sides, or posterior

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*The result of many observations and studies regarding the influence of soil composition or the character of wine, may be summed up as follows: High alcoholic strength is characteristic of wines grown on calcareous soils; color depends on the iron in the soil; smoothness on the alumina and on the variety of grape; bouquet on the silica.

Chambertin, writes Julian, is a wine which has a good color, much sève, is very delicate and smooth, faultless in taste, and possessing the most agreeable bouquet.

The vineyard which produces this wine has the following soil composition:

Alkaline salts	0.031
Carbonate of calcium and magnesium	4.425
Ferric oxide	2.961
Phosphoric acid	0.235
Alumina	2.063
Silica (soluble)	0.110
Organic matter	1.973
Insoluble residue (silica)	89.302

†By œnanthin should not be understood, as perhaps was done by Fauré, a single chemical compound, but rather a complex mixture of ethers.

portion, with a series of sensations which are agreeable or disagreeable, according to the nature of the flavors and their degree of intensity.*

Neutral Flavor (*Sapore neutro*, It.; *Saveur neutre*, Fr.).—A wine is said to be neutral when it has no marked aroma or taste.†

Wines of neutral taste are the best base for the making of imitative wines, as they acquire most easily the taste of the wines with which they are blended.

Vapid, Flat, Insipid (*Insipido*, It.; *Plat*, Fr.).—A wine is vapid when it is lacking in alcohol and vinosity, or when, without having any defect

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* With regard to tastes in general, writers are at variance. The greater or less number of tastes and the possibility of their classification have been discussed.

The number of tastes may be considered as infinite, and therefore a classification almost impossible. Such classification, however, has been attempted. Haller distinguishes twelve tastes, which have been reduced by Linnæus to ten: sweet, acrid, fatty, astringent, bitter, viscous, saltish, watery, and insipid.

Vintschgau proposes another taste—metallic.

Physiologists distinguish in the sense of taste four specific energies, that is, four elementary sensations, viz.: sweet, bitter, acid, and salt. The first two affect only the nerves of taste; the acid taste, on the other hand, if too strong, may cause pain, for which reason Vintschgau believed that acid and salt tastes affect also the sense of feeling, as is seen in touching concentrated solutions of acids.

Nothing is known with certainty as to the way in which different tastes are distinguished, and we must be content with supposing that each flavor—sweet, sour, bitter, salt—acts upon special nerves which serve to distinguish them. This is the more probable, as different parts of the tongue are unequally affected by different tastes. We are still more in the dark regarding the intimate nature of the tastes, the chemical composition of the substances which they characterize seeming to have no connection with them.

The chemical composition of a substance has nothing to do with its sweet, bitter, or salt taste; with regard to the acid taste, however, it may be said that every substance which tastes acid is also an acid from the chemical point of view.

† The vineyardist in making a choice of varieties to plant should keep in view the flavor which they will give to his wine. If he is planting in a new locality, where it cannot be known what kind of grape will there best develop its flavor, he should choose a variety which gives a wine of neutral taste.

The French, who are masters of the art of imitating wines, have this maxim: "There are more buyers than there are connoisseurs."

Trusting to the truth of this saying, they have been able to establish that great commerce of wine which has become one of the principal sources of riches to France. The cities of Cette, Bordeaux, Marseilles, Lunel, Montpellier, and others of the south of France are centers of the production of large quantities of "wines of imitation."

Do you wish to make, for example, a hectolitre of fine Bordeaux?

Take—

Red wine of the south (Roussillon or Narbonne)	60 litres.
White wine of good quality	25 litres.
Old wine of Alicante	12 litres.
Old wine of Malaga	3 litres.
"Conservatore enantico"	25 grammes.

The œnanthic conservative is dissolved in about a litre of warm white wine; the whole is then well mixed and allowed to stand for two weeks. During this time a slow, insensible fermentation goes on, which completely mixes or blends the ingredients.

The wine is then drawn into sulphured casks, clarified, racked again, and the Bordeaux is made.

This, however, is too expensive a Bordeaux; here is a cheaper one:

Red common Spanish wine	70 litres.
Wine of Narbonne	25 litres.
Wine of Malaga	5 litres.
Bordeaux extract	A quarter of a bottle.
Œnanthic conservative	30 grammes.

This is treated in the same way as the first.

If a still cheaper Bordeaux is desired—

Ordinary red wine	81 litres.
Roussillon and Narbonne	15 litres.
Old brandy	4 litres.
Bordeaux extract	A quarter of a bottle.
Œnanthic conservative	30 grammes.

The above information is for the edification of those who prefer a bottle of this Bordeaux to a bottle of Chianti, of Valpolicella, of Valtellina, and of many other Italian wines which are far superior to these French concoctions.

due to secondary fermentations, it lacks some of those qualities which together render a wine agreeable.

An insipid wine may have plenty of color, however. Insipid wines are very subject to unfavorable changes.

SAPID (*Sapido*, It.; *Sapide*, Fr.).—A wine is described as sapid; it is meant that the acids are agreeable in quality and proportionate in quantity.

VINOUS, VINOSITY* (*Vinoso*, *Vinosita*, It.; *Vineux*, *Vinosité*, Fr.).—A wine is said to possess vinosity when it imparts in a certain degree that sensation of warmth characteristic of the alcoholic flavor.

WEAK (*Debole*, *Vino che scappa in bocca*, It.; *Faible*, *peu alcoolique*, Fr.). A wine is said to be weak when it is of low alcoholic strength, or when its alcoholic contents are not in proportion to its other constituents. Wines of this character have in general little flavor, are insipid, and difficult to keep, on account of the gummy or mucilaginous substances which they contain, and to which they owe what little flavor they have.

LIGHT (*Leggero*, *Sottile*, It.; *Leger*, *Mince*, Fr.).—A light wine is one which is of good quality, but at the same time contains a relatively small amount of color, body, and alcohol, no prominent flavors, and no sweetness. The general effect of a light wine is one of delicacy, though there exists a just equilibrium between the various constituents.

SOFT, MILD (*Molle*, It.; *Mou*, Fr.).—A mild wine is one which does not affect the palate by its harshness or astringency, as do rougher wines. Softness characterizes wines which are neither sweet nor dry, and not too alcoholic.

ALCOHOLIC (*Alcoolico*, It.; *Alcoolique*, Fr.).—When a wine is spoken of as alcoholic, it is generally meant to be one containing a relatively high per cent of alcohol, but of an unsatisfactory and unsatisfying quality.

GENEROUS (*Generoso*, It.; *Genereux*, Fr.).—A generous wine is one with plenty of alcohol, but of a smooth, warming, strengthening character; one of which a small glass produces a feeling of well-being and sensible tonic effects.

WARM, HOT (*Caldo*, It.; *Chaud*, Fr.).—A hot wine is one containing a good deal of alcohol, which produces a somewhat burning sensation in the mouth and stomach.

SHARP, LIVELY (*Vivo*, It.; *Vif*, Fr.).—This is said of a wine which, without being pronouncedly acid or alcoholic, affects the palate vividly. It is a quality compatible with lightness, but not with smoothness.

FULLNESS, ROUNDNESS (*Stoffa*, It.; *Étoffe*, Fr.).—Expressive of a robust homogeneity, which gives the impression of solidity and good constitution.

BODY (*Corpo*, It.; *Corps*, Fr.).—A wine is heavy bodied when it is rich in extractive matter and has high vinosity.

HEADY (*Fumosa*, It.; *Fumeux*, Fr.).—Wines which contain much carbonic acid, and thus go quickly to the head, produce effects that are usually confounded with those of drunkenness, but which, in reality, differ very much from them physiologically. Wines of this character are unwholesome.

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* Many use this word in a somewhat different sense; by it they mean "wine-like;" that is, having a full supply of the quality or qualities which preëminently distinguish wine from other alcoholic beverages.—*Trans.*

DENSE, PULPY (*Carnoso, Polputo, Maccherone*, It.; *Charnu, Pulpeux, Lourd*, Fr.).—Expressive of a wine that has what one might almost call a pasty consistency.

HEAVY, COARSE (*Grave, Gravonè, Pesante, Capitoso*, It.; *Lourd, Gros, Pesant, Capiteux*, Fr.).—Wines which have much body and little alcohol, and which, even when drunk in small quantities, go to the head and weigh on the stomach.

CLEAN (*Franco*, It.; *Franc*, Fr.).—Said of a wine which does not leave the slightest suspicion of any taste indicating unsoundness, or of any defect due to the bad condition of the grapes from which it was made, or to neglect or improper handling of the wine.

HARMONIOUS (*Armonico*, It.; *Harmonique*, Fr.).—Well constituted. This is said of a wine when its constituents are in exactly the proper proportions, well balanced and blended, forming a perfect whole, which is at the same time pleasing and satisfactory.

WINE THAT ENDS WELL (*Vino che finisce bene*, It.; *Vin qui finit bien*, Fr.).—This is an expression used by the taster to define an impression that remains for a certain time after drinking a fine wine; it means a wine in which the constituents are harmonious, and remain so even after the wine has passed from the mouth, impressing the senses with nothing but pleasing sensations to the end. These sensations continue even after the wine has been swallowed, insomuch that one might almost say that it wished to prolong the pleasure of the drinker by a fresh visit to the organs of taste.

WINE THAT ENDS QUICKLY (*Vino che finisce presto*, It.; *Vin qui finit vite*, Fr.).—Wine that leaves but an ephemeral sensation in the mouth; that is to say, almost as soon as the wine is swallowed all trace of it is gone, and the palate, tongue, and stomach seek in vain to recall its character, flavor, bouquet—all have gone, all have disappeared.

WINE THAT ENDS BADLY (*Vino che finisce male*, It.; *Vin qui finit mal*, Fr.).—A wine that after swallowing leaves a disagreeable taste, bitter, woody, etc., in the mouth.

DELICATE (*Delicato*, It.; *Delicate*, Fr.).—A wine to be delicate must be perfectly harmonious, soft, and agreeable.

FINE, OR HIGH QUALITY (*Fino*, It.; *Fin*, Fr.).—A wine that unites a natural delicacy with an exceptionally agreeable flavor and delicious bouquet.

MUTE (*Muto*, It.; *Muet*, Fr.).—Said of unfermented or only partially fermented wines; they are characterized by a sweetish or gummy taste. They are wines which have been made from musts treated with sulphurous anhydride or fortified with alcohol. The wines that are generally made "mute" are white wines that are to be used to sweeten liquors or to increase the sugar contents of new wines, or that are to be used for the manufacture of syrups by concentration in vacuo.

When a wine is made mute by the use of sulphurous anhydride, the risk is run, if too much is used, of giving the wine, first, a taste of sulphhydric acid, and afterward more or less pronounced bad flavors due to the sulphates that are formed.

These wines are kept in cool cellars, where the temperature is as nearly as possible constant, and in strong and well-hooped casks. They ought to be clarified, preferably with gelatine. In order to obtain a perfect clarification, about 8 or 10 grammes of tannin are added to each hectolitre before putting in the finings (one tenth per m., or about 1.25 ounces per 100 gallons).

SMOOTH (*Vellutato, Morbido*, It.; *Velouté, Moelleux*, Fr.).—A smooth wine fills the mouth with its grateful flavors and fagrance, imparting its delightful series of sensations without the slightest harshness.

This quality is due to the presence of a certain quantity of glycerine, and not to glucose, as at first one might be inclined to think. In this latter case the wine would be called "amabile" (fruity).

It is glycerine rather than glucose which gives a wine that kind of smoothness which might almost be called unctuosity.

In very high-class wines the smoothness or unctuosity is due not only to glycerine, but also to other bodies which have not yet been well studied; they occur more especially in wines of very favorable years; that is, of years when the season has been so propitious that the grapes have been able to attain an exceptionally perfect maturation.

Many chemists have attempted to determine the nature of these substances.

Il Fauré, who studied the wines of the Gironde, believes that this unctuosity is due to the same substance as sève, a substance which is of similar character to pectine and mucilage, and which he called "œnanthin."

Batilliat claims to have found in the high-class wines of Bordeaux the peculiar substance which causes their unctuosity, and which he calls "croatine."

Mülder, on the other hand, from observations made on the wines of the Gironde, considers this unctuous substance as analogous to dextrine.

Whatever may be the nature of this substance, it is useful to know that the wines in which it occurs, if not well kept, are liable to undergo an almost insensible fermentation, which destroys this substance, and so takes away from the wine that quality which is due to it; pasteurizing or heating will also deprive a wine of this quality.

FRUITY (*Amabile*, It.; *Suave*, Fr.; the Latin, *Suavis vel subdulcis*).—A wine which is very faintly sweet on account of retaining a small quantity of grape sugar or glucose.

As is said sometimes: "*Quel vinetto cosi amabile va giù senza accorgersene.*"

Technically, a fruity wine cannot be said to possess sève because it tends towards sweetness. However, a wine which is very slightly sweet may possess a good sève in the sense that it produces those sensations which are the quality of wines of the highest class.

SWEETISH (*Dolcigno*, It.; *Doucereux*, Fr.).—A wine is said to be sweetish when its sweetness is undecided, unsatisfactory, and not in harmony with the other components of the wine; it is due usually to a bad fermentation and incomplete defecation, or it may be, with an ordinary table wine rich in mucilaginous substances, that it is becoming sick or undergoing one of those insensible fermentations, that is, the tartaric fermentation, to which such wines are so subject in the spring. In the latter case there is a moment when the wine can be detected in becoming slightly sweetish, and if prompt measures are not taken it will in a short time be completely spoiled. This turning flat and sweetish is due to the mucilaginous substances which, under the action of dilute acids and a favorable temperature, become transformed into substances resembling dextrine and other saccharine matters, which give place, or rather favor, when the alcoholic fermentation has not been of a thorough character, the development of secondary fermentations.

SWEET (*Dolce*, It.; *Doux*, Fr.).—A sweet wine is one in which the sweetness is pleasant, because not excessive, and in harmony with the other principal ingredients, and more particularly with the alcoholic contents.

> "*Il vino dolce e glorioso*
> *Rende l'uomo pingue e carnoso*
> *E allargo lo stomaco.*"

OVER SWEET (*Dolciastro*, It.; *Douceâtre*, Fr.).—This is said of wines which are too sweet, or in which the sweetness does not seem to be well combined; that is, the sugar seems to have been lately dissolved in the wine.

HONEY SWEET, SICKLY SWEET (*Dolce smaccato*, *Melacchino*, It.; *Doux fade*, *Mielleux*, Fr.).—Of white wines when they are very sweet and of a nauseating sweetness, resembling must more than wine.

Melacchino is perhaps a corruption of *melichino*, meaning cider—*vinum ex malis*, *pomatium* of the Latins.

NEW OR YOUNG WINE (*Vino giovane*, *nuovo*, It.; *Vin jeune*, Fr.).—A wine which has been made but a short time, and which has not undergone those changes and transformations in its composition through which it acquires new qualities, due to the new substances which are formed, and which render it more agreeable to the palate, and in the case of fine wines impart bouquet and even sève.

Another cause of variation in the character of wines is the deposition in whole or in part of various substances on the walls of the cask, or in the form of lees at the bottom, that are thus eliminated from the composition of the wine.

These young wines, compared with their condition at maturity, are more heavy bodied, more deeply colored (green or acid), more astringent, and sometimes rough and harsh.

These wines are, finally, more nutritious than after they become mature; it must not be forgotten, however, that a wine which is too young is somewhat indigestible.

GREEN (*Verde*, *Verdetto*, *Bruschetto*, It.; *Vert*, *Aigrelet*, Fr.).—Green wine is not synonymous with young wine, as might be supposed at first; greenness is a quality which a new wine may and generally does have.

A wine is said to be green when it has an acidity and roughness which, though pronounced, is of such a character that it will disappear with time.

Thus, incompletely ripened grapes give a green wine, owing to a small quantity of volatile acid and acid salts which they contain, and more especially bi-tartrate of potash.

Greenness is characteristic of certain new wines, and also of many mature wines produced in northern countries.

TART (*Acidulo*, *Acidetto*, It.; *Acidule*, *Aigrelet*, Fr.).—Said of a wine possessing an agreeable and sufficient acidity, due to the presence of free tartaric acid and sometimes of carbonic acid, especially when this latter is in such amount as to become free easily, and so affect sensibly the tip of the tongue.

HARSHLY ACID (*Acerbo*, It.; *Acerbe*, Fr.).—Expresses a sharp, harsh acidity, like that in sour or unripe fruit, which puts the teeth on edge and draws up the lips and mouth. This acidity comes from immature seeds or green stems, which communicate their acids, such as malic, racemic, etc., to the wine; in other words, the acid is the same chemically as that found in unripe fruit.*

Wine produced from grapes which for some cause or other have not reached their maturity, are always more or less harshly acid.

With time this repellant acidity disappears, for the reason, according to Dessaignes, that the malic acid, after eight or ten months, decomposes into succinic and butyric acids.†

MATURE WINE (*Vino maturo*, It.; *Vin mûr*, Fr.).—A mature wine is one which has quite developed all its characteristic qualities, and which is therefore ready to be drunk, or to be placed in bottles, where, in aging, it will go on improving.

DECREPIT WINE (*Vino decrepito, passato*, It.; *Vin passé, affiabli*, Fr.).—The caducity of a wine is the stage, according to Dr. Guyot, where it has passed its prime maturity, and when it has already commenced to deteriorate; when, in other words, it has lost some or all of the qualities due to its volatile principles and other constituents.

A decrepit wine has lost its fragrance, has become flat; it has not contracted any disagreeable or repelling flavor, for the taste of *age* that these wines have cannot be called disagreeable in the same sense as a wine which is attacked by the disease called *bitterness*, but it has a slight bitterness which recalls that of some resinous substances.

These wines, when they find themselves in favorable conditions, as when exposed to the air, decompose readily.

"A wine which has been exposed to the cold of winter and the heat of summer acquires in the month of September the taste which Italians call 'settembrino,' which is exhausted and 'passé.'"—M. Salvini.

DRY‡ (*Vino asciutto*, It.; *Vin sec*, Fr.).—This is said of a wine which leaves in the mouth a sense of dryness. It is a characteristic of highly alcoholic and somewhat astringent wines. "*Pomino* leaves the mouth dry," say the Tuscans. A dry wine is not only without even the slightest taste of glucose, but it does not contain, or only in the most minute degree, the quality of smoothness due to a certain quantity of glycerine, and, in the case of high-class wines, of other substances.

ASTRINGENT (*Aspretto*, It.; *Un peu âpre*, Fr.).—When the tannin is somewhat noticeable.

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*This acidity must not be confounded with that due to the acetification of the wine. This excessive acidity may be amended by an indirect method, which is that suggested by Gall, and which aims to correct the must before fermentation. Or some may have recourse to "marmorizzazione;" that is, the addition to the wine of powdered calcium carbonate (marble), which is, however, a method which cannot be very highly recommended, and when necessary, Liebig's method is much to be preferred. This method is to add to the wine a concentrated solution of neutral tartrate of potash in such proportion as to bring down the acidity to the desired degree.

As a preliminary test, to ascertain with an approximation near enough for practical purposes, several quart bottles are filled with the wine to be treated, and to each bottle is added a certain quantity of the solution of neutral tartrate of potash, each bottle being given a slightly greater dose than the one before. The bottles are then corked and left to themselves for a few days. They are then tasted, and the one giving the desired result is used as the basis of calculation for treating the whole quantity.

† The organic acids contained in the must are the following: Tartaric, racemic, malic, citric, tannic, palmitic, stearic, etc.

The acids, on the other hand, which are produced by fermentation, the oxidation of the alcohol, or the breaking up of the sugar, are: Carbonic, acetic, propionic, butyric, valerianic, capronic, œnanthilic, pelargonic, succinic, lactic, etc.

‡ This is a restricted use of the term *dry*, somewhat different from its more general meaning, which is simply *not sweet*, that is, containing no glucose.—*Trans.*

ROUGH (*Austero, Pavido, Allappante*, It.; *Austère, Âpre, Picotant*, Fr.).—These terms are used of wines which, on account of their excess of tannin, or rather œnotannin, are in the highest degree rough and astringent. Their flavor, which is somewhat nauseous, recalls immediately that of ink, or of ferruginous substances.

In drinking a rough, overastringent wine, a feeling of dryness is produced on the tongue and along the œsophagus. The daily use of wines of this character, by persons of delicate constitution, may occasion organic disorders.

This roughness tends to diminish with time, and may completely disappear; the cause being that the tannin, under the influence of oxygen, gives place to a slow formation of carbonic and gallic acids.

Œnotannin* possesses tonic properties, and insures the conservation of the wine by causing coagulation, and consequently the elimination of many substances which the wine contains, substances whose presence is dangerous from their instability, and because they favor the development of those organisms to which are due secondary fermentations.

High-class and fine wines when young, and even sometimes when old, are more or less markedly rough; this roughness they lose with time.

HARSH (*Duro*, It.; *Dur*, Fr.).—Harsh wines are generally young wines rich in tartar and tannin, and which, consequently, leave a repellant impression on the papillæ of the tongue and palate.

Harsh wines are lacking in delicacy and value.

Harshness, of itself, is a defect; ordinarily it is due to the soil, and in that case the wine is also heavy bodied. This defect may also be owing to unskillful preparation or handling.

Harsh wines keep easily, and can be kept for a longer or shorter time, according to their quality.

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*Œnotannin has the property of forming with gelatine and with albumen voluminous insoluble compounds, which precipitate with great readiness. By means of clarification, therefore, the contents of œnotannin can be notably diminished, thus curing, or at least considerably lessening, the defect of roughness.

I have called roughness a defect, but that should be understood relatively, not absolutely, for it should not be forgotten that the general trade demands a certain roughness, and wines in which it is lacking are often given this character artificially by the addition of alum, which is undeniably an adulteration, or by the addition of tannin.

Alum is used by unprincipled dealers, and has the quality of reviving the color, precipitating the albuminoids, and imparting a roughness, almost styptic, analogous to that presented by the common Bordeaux wines.

The wine maker has the choice of two kinds of tannin which are found in commerce, and which differ in their mode of extraction or preparation. Thus, the tannin may be extracted from galls by means of ether, giving a tannin pure, but retaining a taste of ether, which renders it objectionable in the treatment of wine. The other kind, which is extracted by alcohol, is inodorous, and therefore preferable for the wine maker.

Pure tannin dissolves completely in alcohol, and in water mixed with 10 per cent of alcohol, and the solution should be limpid. When the wine maker needs tannin he can make use of the grape seeds, which contain a considerable quantity; the seeds may be used either fresh or dry, the latter being more convenient, as they can be preserved from year to year.

It is to be remarked that clarification attempted with isinglass, gelatine, or white of egg, does not always succeed; the failure is due to the lack or insufficiency of tannin in the wine, or to its superabundance.

This explains the common usage of adding tannin to white wines before attempting to clarify them; or in the case of highly tannic red wines why, after adding the clarification, it is often necessary, in order to produce perfect limpidity, to have recourse to sulphuring and racking. This is what the cellarman means when he says that the wine has not taken the finings.

Wines which have fermented slowly, and which contain substances resembling humic compounds, can sometimes be fined even when lacking in tannin.

It is also worthy of remark that tannin has a great influence on the color of wine; it tends to increase it, and, according to M. Nessler, if the wine remains for some time in contact with the lees, it prevents, to a great extent, the diminution of the color.

The life of ordinary or common wines, which are harsh, is limited to a few, two or three, years. These wines in losing their harshness gain little or nothing in value, in fact, as they lose the defect of harshness, they acquire another, that due to tartaric fermentation.

Harsh wines which have good quality and body keep for a long time, and after some years lose their harshness; they thus become more homogeneous, harmonious, and pleasing, or as the experts express it, they become rounded.

If these wines are drunk before they have lost a portion of their harshness, they are not very hygienic.

BITTERISH (*Amarognolo*, It.; *Un peu amer*, Fr.).—This is not a defect; it is even up to a certain point a good quality; that is, when the bitterness is very slight, delicate, aromatic, in short, pleasing; as a rule, a slight touch of bitterness is characteristic of densely colored wines.

Very often this quality is due to the presence of carbonic acid in solution; for example, in young wines or those which have been treated by the Italian method called "il governo."*

Sometimes, in the common language, all wines are called bitter, but with impropriety, which are not sweet; from which the Tuscan proverb, *Vino amaro tienlo caro*, which means, the wine which is not sweet is always of best quality.

BITTER (*Amaro*, It.; *Amère*, Fr.).—Bitterness is a defect, and may be due, as in general it is, to a real malady caused by a micro-organism.

"*L'amertume est pour nous la maladie organique des vins de Pinot.*"—Vergnette Lamotte.

Wines of this kind have a harsh, repelling, nauseating bitterness, due to secondary fermentations, or in the case of young wines, to principles which they have extracted from the skins or stalks during fermentation.

According to M. Nessler the tendency of a wine to this disease is augmented by remaining long in contact with the pomace.

The bitter taste affects principally the posterior portions of the tongue and palate, and the sensation persists for some time.

This fault, which most œnologists consider confined to red wine, is found also, we are told by M. Ottavi, in white wines. He claims to have encountered it in the white wines of Piedmont.

Nessler observes that white wines are less subject to this defect or malady than red, thus admitting, by implication, that they do sometimes become bitter.

The bitter secondary fermentation may develop in any wine, but is more frequent in fine and delicate wines. In common wines the disease usually occurring is the tartaric fermentation.

In general, highly colored wines, rich in extractive matters, are most liable to the attacks of the disease of bitterness.

The high-class wines of Bourgogne, made from the Pinot, not excluding even those made in the most favorable years, are subject to attack by this disease.

In the finest wines Vergnette Lamotte distinguishes two kinds of bitterness: That which attacks the wine during the first two or three years of its life, and which is the most dangerous; and that which shows itself

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*"Il governo" is a method of wine treatment in common use in Tuscany, which consists essentially in maintaining a slow, protracted fermentation in a poor or neutral wine by the addition of half-dried grapes of high quality, or containing an abundance of those substances lacking in the wine treated, as color, body, tannin, etc.—*Trans.*

in old and decrepit wines. This second bitterness, due perhaps more to chemical reactions than to the action of ferments, is only relatively an ill, as the wine can be consumed before it reaches complete decrepitude.

Pasteur holds that even this second bitterness, which Vergnette Lamotte lays to the account of decrepitude, is caused by the same organism which determines the first kind.

This organism may remain inert for a longer or shorter period, till in the course of aging the wine presents the necessary favorable conditions for its development.

In conclusion, I will say that the bitter taste is a somewhat serious defect; a defect which may be more or less marked, as it may be transitory or permanent.*

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* The bitter taste in wine may be the consequence of imperfect maturity of the grapes, owing either to an unpropitious season, or to the damage caused by insect or cryptogamic pests; or it may be the consequence of a secondary fermentation, caused by a micro-organism, *i. e.*, the "bitter ferment," which determines the formation of those substances which impart this taste to the wine. In the latter case we have a true disease.

When the bitterness is due to the principles which have passed from the grapes and stems into the wine, then with time and successive finings and rackings it will disappear. This is explained by the supposition that the nitrogenous substances become impregnated with the bitter principles, and thus, when the former are precipitated, they carry along with them the latter, the wine in this way losing this defect.

The bitter taste, if very pronounced, may not disappear after the first rackings, in which case the wine should be fined with gelatine or white of egg.

If the wine be weak, the coagulation of the albumen may be facilitated by the addition of alcohol.

According to the quality of the wine, it may be given a light clarification with the whites of three or four eggs per hectolitre, or a more energetic treatment with 25 grammes of gelatine.

Such a treatment not being found sufficient, recourse must be had to the use of olive oil of good quality; of this the dose to be used is one half litre per hectolitre. The oil is poured into the wine, the whole thoroughly stirred, and then allowed to rest; the oil separates from the wine, and carries with it the substances which have caused the bitterness.

Directly after racking a wine with access of air, it will sometimes become slightly bitter; this seems to be caused by the action of the oxygen of the air upon substances contained in the wine; later the bitterness disappears, owing very probably to the rapid oxidation which causes these substances to precipitate. In this way M. Mona explains how bitter wines in bottles can, with time, lose this defect.

Formerly various opinions were held regarding this malady, because, in all probability, people failed to distinguish between bitterness proper and the malady due to tartaric fermentation, or "la pousse."

Thus De Blassis attributed it to changes of the salts, especially of bi-tartrate of potash; Machard to an invisible action of the fermentative principle, decomposing the last remnants of sugar and salts in the wine; Lebœuf to an abnormal fermentation, which produced, sometimes, citric ether, which has a bitter taste; Vergnette Lamotte to a secondary fementation, caused by a parasitic vegetation, which decomposed the wine in consuming the coloring matter; Neubauer found that the quantity of tannin and of coloring matter diminished with the progress of the malady. Finally Pasteur, after the study of many bitter wines, has demonstrated that this malady is caused by the action of a micro-organism, which multiplies with extraordinary rapidity in the superior wines of the "Côte d'Or," but very slowly in the common wines of Bourgogne, the Jura, and the Bordelais. He adds that this malady presents many diversities in its development, according to the origin and the nature of the wine, but that all wines are subject to it.

Ducleaux, in 1873, determined the volatile acids of bitter wines, the following being the result of his analyses:

	Volatile Acid.	Total Acidity.	Acetic Acid.	Butyric Acid.
Sound wine	1.01 gr.	4.40 gr.	0.97 gr.	0.04 gr.
Bitter wine (1866)	1.50 gr.	5.15 gr.		
Bitter wine (1873)	1.95 gr.	6.67 gr.	1.83 gr.	0.19 gr.

The increase of total acidity in the sick wine being greater than could be accounted for by the formation of acetic acid at the expense of the alcohol, it must be attributed to the fermentation of the glycerine, which, in fact, had diminished.

Earthy Taste (*Terroso*, It.; *Terreux*, *Goût de terroir*, *Goût de pièrre à fusil*, Fr.).—By the term earthy a single definite taste must not be understood, but divers flavors which are all in general disgusting or bad.

In tasting, these flavors are perceived by the posterior part of the mouth, and may have their origin in the soil, in the use of inappropriate fertilizers, in the plants supporting the vines, or in the weeds infesting the vineyard, etc.

"The *earthy taste* is a vague term," writes Ottavi, and with justice, for it is a taste which is not always very definite, resembling sometimes earth, manure, flint, slate, nuts, willow, grass, etc. It is well known that Aristolochia, Mercurialis, etc., if allowed to grow in the vineyard, communicate their flavor to the grapes, and therefore to the wine. Pliny was not mistaken when he wrote: "In general, the vine takes up with an astonishing facility the flavors of neighboring plants. The grapes grown in the marshy soils of Padua have a taste of willow."

Generally the earthy taste is not found in high-class or fine wines. I say generally, because there are exceptions; for example, Chablis has a slight flavor of flint, and yet it is a wine of a certain renown.

Richelieu, speaking to Louis XV of a certain wine of Graves, said: "*Il sent la pièrre à fusil comme une vieille carabine.*"

The *flinty taste*, writes Petit Lafitte, has something vinous and energetic, which exactly recalls the sensation experienced by the olfactory organs when a flint recently struck by the steel is held under the nose.*

The diminution of the glycerine was also pointed out by Pasteur, who, besides, stated that the tartaric acid did not diminish.

As the researches of Fritz have shown, many microbes are able to cause fermentation of the glycerine; thus, under the action of the *Bacillus butylicus* it is transformed into butylic alcohol and butyric acid.

Recently, B. Hass experimented with a view of ascertaining whether the bitter taste was due to citric ether, as Müller and other French chemists had supposed, or to some resinous substance produced by changes of the aldehyde in presence of ammoniacal compositions having their origin in the albuminoid matters of the wine.

By exhausting a wine which was afflicted with the *bitter* disease, and which he had previously rendered alkaline with ether, he obtained a resin slightly soluble in water, very soluble in alcohol and in acetic ether, insoluble in carbon bi-sulphide, turning brown in contact with the alcohols, becoming greenish with ferric chloride, and having the extremely bitter taste of the diseased wine.

Hass has found by his experiments that the best way of curing a wine afflicted with this malady, is by the use of oxidizing agents. Oxigenated water in small quantities is inefficacious; in larger quantities it destroys the bitter taste, but produces another not less disgusting. The best results have been obtained by aeration.

The wine is fortified by the addition of alcohol till it contains 13 per cent by volume, if of feeble character and liable to acetify. A current of air is then passed through the wine for two hours, and the bitterness disappears completely.

Filtration through pomace or cellulose has an excellent effect, the bitter substance seeming to be removed by physical attraction.

This disease may be said to have several stages. At first the wine is still clear, but less fragrant, duller in color, and with a slight bitter taste. Later it acquires an odor *sui generis;* the bitter taste increases, becoming piquant on account of the small quantity of carbonic acid produced by the secondary fermentation which takes place. Finally it loses its natural color, becoming brownish, with a tendency to blue; there has then taken place a serious change in one of the principal components of the wine—the extractive matter—and the wine has become an undrinkable liquid.

* According to Doussieux, the earthy taste is due probably to the solution and evaporation of a part of the mineral and metallic substances which are found in the soil of certain vineyards.

Petit Lafitte seems inclined to attribute the flinty taste to iron and alumina.

Ladrey, on the other hand, accounts for it by the presence of much silica in the soil, and many analyses show silica not only in the leaves and seeds of the vine, but also in the wine.

Joulie states that the flinty taste is due to the fact that pyroniac silica contains a bituminous substance of organic origin, the peculiar taste of which is communicated to the wine.

It should also be remembered that the experiments of Thenard prove that silicate of lime is much more soluble in water than was formerly believed.

According to the experiments made by Aubergier, the principle to which wines owe their earthy taste is found neither in the seeds nor in the stems, but in the skins of the grapes. From 15 kilogrammes of pomace he extracted 30 grammes of a volatile oil so acrid and penetrating that a single drop was sufficient to infect 10 litres of the best brandy.†

This fact supports the opinion of those who see in the prolonged contact of the wine with the pomace the cause of the earthy taste.

Certainly, by improving the soil, by the use of proper fertilizers, by a good defecation of the must, by a prompt removal of the wine from the pomace, by clarification and rackings, the taste under discussion is much diminished, and sometimes completely eliminated.

TASTE OF SOIL (*Sa di terra*, It.; *Goût de terre*, Fr.).—When the wine has that taste of soil or of clay, due to the presence of soil in the must during fermentation. The soil in the must may come from the skins of the grapes, which may easily become covered with it when the bunches lie too close to the ground, or may have become mixed with the grapes accidentally or by carelessness.

This taste may come, also, from the clay which the peasants sometimes use as cement to close the leaks in tubs, vats, or other utensils.

TASTE OF BRINE, SALT (*Sa di salmastro, di salso*, It.; *Goût de saumâtre, de salé*, Fr.).—The wine has sometimes the taste of common or culinary salt.

This defect is found in wines grown in soil rich in salt, or in localities near the sea.

COOKED TASTE (*Sa di cotto*, It.; *Goût de cuit*, Fr.).—If the wine has a taste more or less pronounced of must or caramel, due generally to the action of fire upon the must when the latter has been concentrated carelessly, or by direct heat.

This taste is caused, also, by an over-maturity of the grapes, as happens in very hot weather, and especially when the grapes are thick-skinned; it may be caused, also, by frozen grapes, or by the freezing of the wine; in the latter case especially when the pieces of ice formed in the wine are not carefully removed.

RESINOUS TASTE (*Sa di resina*, It.; *Goût de resine*, Fr.).—This taste is found in wines which have been kept in receptacles made of resinous wood.

BREAD TASTE (*Sa di pane*, It.; *Goût de pain*, Fr.).—Some sweet liquor wines have an agreeable taste which reminds one of the odor of fresh bread.

TASTE OF DRUGS, MEDICINAL TASTE (*Sa di droghe*, It.; *Goût de drogues*, Fr.).—A taste due to the addition of some infusion or drug to the wine.

Regarding the quantity of silica contained in wine, we have the analyses of Boussingault, who, in analyzing his wine grown at Smalzberg (Bas Rhin), found 6.096 gr. of silica per 1.870 gr. of ash in a gallon of wine, 5 per cent of the mineral ingredients.

Grasso, in the ash of four different musts, found the following quantities of silica:

Petit Bourgogne (not mature)	1.991 per cent.
Petit Bourgogne (mature)	2.099 per cent.
Petit Bourgogne (mature, but from a different soil)	1.191 per cent.
Grün Sylvaner (white, mature)	2.181 per cent.

In the skins the proportion was greater; in those of the first it was 3.464, and 2.571 in those of the fourth.

† That a drop of this oil is capable of infecting so large a quantity of brandy is not wonderful, when we reflect on the sensibility of our organism, especially of our sense of smell, which is so susceptible as to surpass the extremely delicate spectroscope. Thus, for example, Valentin has shown that one five hundred thousandth of a milligramme of sulph-hydric acid, or one two millionth of a milligramme of essence of roses, is sufficient to make an impression on our olfactory organs.

Burnt Taste (*Sa d'abbruciato*, It.; *Goût de brûlé*, Fr.).—When the wine has a flavor of acrid fruit, together with a spurious cooked taste.

The taste of which we speak is a consequence of the partial withering of the grapes before their maturity, on account of extreme heat or of great changes of temperature between night and day.

Mousey Taste (*Sa di topo*, It.; *Goût de souris*, Fr.).—A wine will sometimes have a disgusting flavor and odor that recalls forcibly the odor of the excrements of mice. The cause of this defect is not well known. According to some authorities, it is due to lack of cleanliness in the receptacles in which the wine is kept. Others believe it to be caused by the action of the oxygen of the air on the extractive matter of the wine, for there seems sometimes to be a distant analogy between the mousey taste and the fresh bread taste so much appreciated in some liquors. It is very probable that both of these causes concur to produce this taste, for it is found sometimes even in wines which have been kept in glass.

The mousey taste may be more or less intense, and wines affected produce a dry feeling in the mouth when they are tasted. If a wine has this taste in a very slight degree it is not noticed immediately; it often happens that after passing judgment on a wine, one's opinion has to be modified by a mousey taste which is not perceived at first. If the defect is pronounced, it is perceived immediately by the nose; the odor and taste too, in this case, are so disgusting as to be sickening.

Heated Taste (*Sa di riscaldato*, It.; *Goût de réchauffé*, Fr.).—This unpleasant flavor is hard to define, as, in fact, it is a mixture of various flavors—of acetic acid, of stems, of organic matter slightly decaying under the influence of heat and moisture, etc.

This taste is easily produced by allowing the cap to become overheated during fermentation, or by heating grapes before crushing them.

With time this taste tends to disappear, but when somewhat pronounced it diminishes, leaving the wine with a somewhat acrid taste.

Sulphur Smell, or better, **Smell of Sulph-hydric Acid**.—An odor resembling rotten eggs which a wine may have, and which is due to the presence of sulph-hydric acid or suphuretted hydrogen.[*]

Taste of Stale Eggs (*Sa di uova stantìe*, It.; *Goût d'oeuf gaté*, Fr.).—This taste, which is easier to avoid than to cure, comes from the use of eggs not perfectly fresh for fining.

Odor of Sulphurous Acid, or of Sulphur Vapor.—A wine often has the odor characteristic of this substance when it has been recently racked into an excessively sulphured cask.

As every one knows, things that are useful when used in moderation become dangerous when used in excess. This is the case with sulphurous acid.

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[*] It is generally held that the cause of the formation of sulph-hydric acid in the wine is the presence of sulphur in the fermenting mass, as happens when the vines have been sulphured in such a way as to allow sulphur to adhere to the grapes. This is indeed the principal cause, but not the only one. Nessler cites six of these causes, which are: The sulphuring of the vines; the sulphuring of casks; the use of sulphur tape; the use of certain fertilizers; the cultivation of the vines in certain soils; the presence of iron in the vats or casks.

To these causes, most probably, should be added another, that of the reduction of sulphates by micro-organisms, a reduction first noticed by Planchud, who attributed it to vital action. This action has been found by Etard and Olivier to be due to algæ of the group of oscillators, called *Beggiatoa* (*B. roseo-persicina*, *B. mirabilis*, *B. alba*). Other algæ of the genus *Ulothrix* have the same property.

Is it not possible that micro-organisms might be found in wine resembling and acting in the same way as these algæ found in sulphurous waters?

The fine experiments of Dubœuf and J. Bruhl on the action of sulphurous anhydride, or acid, on micro-organisms, have an important bearing here.

They have deduced from their experiments the following conclusions:

1. Sulphurous acid gas has an evident microbicidal action on the germs contained in the air.
2. This action is especially perceptible when the air is saturated with water vapor.
3. Sulphurous acid acts particularly on the germs of bacteria.
4. Pure sulphurous acid will destroy germs, even in the dry state, if the action is sufficiently prolonged.

Sulphurous acid, when used in excessive quantities, takes away from the quality and color of the wine, and gives it a bitterish, astringent, and displeasing taste. In time the sulphurous acid changes to sulphuric, and then into sulphate of potassium. This is why in many wines is found a certain quantity of this sulphate, which is dangerous to health, and, when sufficient of it is present, would lead to the belief that the wine had been plastered.

At the end of the last century it was shown that a wine sulphured to excess acquired a very disagreeable odor, and was hurtful to the health, causing headache, vertigo, oppression of the stomach, nausea, etc.

In practice it is good to remember that the more alcoholic a wine the more sulphurous acid it will dissolve or absorb.

Nessler, making a comparison of water and wine at 9 per cent of alcohol, filled a barrel quickly with each, after having burned as much sulphur as the air in the barrel would consume, and found that the water absorbed .01035 per cent of sulphurous acid, and the wine .01346 per cent.

The quantity of sulphurous acid which a wine will absorb in process of keeping cannot be exactly stated, as it depends on the number of sulphurings, the amount of sulphur burned, or, when the sulphur is burned directly in the cask, on the amount of oxygen there.

According to Weigert the quantity of oxygen in a cask of one hectolitre is 21 litres or 30 grammes. By burning an equal quantity of sulphur 60 grammes of sulphurous acid are formed. When the cask is filled all this is not dissolved, because part is oxidized immediately, and part escapes into the air as the wine enters the cask; thus, the total amount absorbed by the wine is reduced to about 10 or 11 grammes.

Various Odors (*Violet, Rose, Mignonette, Pink, Bitter Almonds, etc.*).—These are all odors given artificially to the wine to render it more fragrant, or to attempt to pass it off as a wine of higher quality than it really is.

Many high-class and fine wines, in aging, develop characteristic bouquets; but besides bouquet these wines have sève, which artificially perfumed wines lack altogether or have little of in proportion to their fragrance.

Besides the odors which we call good, which have been added artificially, we have also bad odors which are absorbed from the air by the grapes or the wine, such as the odor of tobacco, of grass, etc.

Wood Taste (*Sapor di legno, Asciutto, Sa di secco*, It.; *Saveur de bois, Seche, Goût de sec*, Fr.).—A taste not easily defined, as it lies somewhere between that of wood and of mold. It is communicated to the wine by ill-kept casks which have become "secco, asciutto," a defect seeming to be due to the development of mold in the inside of the cask. Sometimes wine will acquire this taste when left long with ullage or in imperfectly closed casks.

To remove this taste recourse is had to olive oil, lemons, or refermentation with a small quantity of fresh grapes.

"*Se egli sappia di secco, il vino, vi abbia odor cattivo, caccinvisi dentro fiaccole acuse, e vi si spengano.*"—Soderini.

Taste of the Stems.—This is a rude, unpleasant taste, vulgarly known as a taste of "legno verde" (green wood). It is found in wines which have been allowed a too prolonged contact with the stems, or which have been made by a maceration of the whole bunch, or which have been made from bunches not perfectly sound. The taste of stems is generally accompanied by some bitterness.

Clarifications and rackings with contact of the air will often destroy or notably diminish the stem taste.

When it is desired to prolong the contact of the wine with the pomace, stemming is to be recommended.

Smoky Taste.—This taste resembles the smell of burning wet or green wood. It is, writes Mona, somewhat acrid and bitter, recalling smoke and soot. According to Mona, it is found more rarely in Italian wines than in German.

This defect may be occasioned by the smoke given off by ill-constructed stoves used to heat the fermenting-room or cellar; or it may be due to unfavorable climatic conditions during the vintage.

It has been stated that musts corrected by the addition of cane sugar will sometimes give wines with this taste.

With the smoky taste a wine loses its brightness, becomes cloudy, and if not cured by sulphuring, changes into a liquid not to be tolerated by even the most uncritical palate.

Oak Taste.—A taste which a wine will contract after two or three rackings into new casks which have not been properly prepared, especially if they are made of a bad quality of wood. The wine in this case acquires a peculiar, bitterish taste, according to Ottavi, almost aromatic, much tannin, and often the real flavor of the wine is quite destroyed.

Taste of Mercaptan.—The repugnant taste and odor of onions or garlic, which remains even after the wine has been racked into well-sulphured casks.

The same causes which tend to produce hydrogen-sulphide in the wine, not excepting plastering when it is done heavily, tend also to form mercaptan. So far no means have been discovered of removing this taste from wine.

Polacci was the first to observe the formation of these products, which have a fetid and persistent odor, and are due to the action of sulph-hydric acid and sulphur on the components of the must and wine; he believes them to be simply ethylic mercaptan. Konig thinks that this reaction is not very probable, as it has never been known to take place in a dilute acid solution. He believes, on the contrary, that the aldehyde contained in most wines combines easily and directly in a dilute acid solution with sulph-hydric acid to form thio-aldehyde and trithio-aldehyde. Now these compounds are endowed with a strong, persistent, and disagreeable odor, resembling closely that acquired by wines containing sulph-hydric acid; it may be, therefore, that the mercaptanic substance spoken of by Polacci is nothing but thio-aldehyde or trithioaldehyde.

Taste of Lees.—Wine, by a prolonged contact with the lees, loses its clean taste and acquires a more or less pronounced bitterness, which has a distant resemblance to a taste of decay, and is characteristic of lees even when sound.[*]

Taste of Decay (*Sapore di fradicio*, It.; *Saveur de pourri*, Fr.).—A taste which the wine contracts from unsound cooperage or too prolonged contact with the lees; it is a repelling taste of rottenness, which, however, must not be confounded with that caused by putrid fermentation of the wine.

This taste may also originate in imperfectly ripened grapes, which, through the prolonged action of dampness, have commenced to decay.

If the grapes are ripe before they commence to decay, the wine will still have something of this taste, but it will be less disgusting and will tend to disappear with time; the wine will, however, always be insipid, and lack frankness of taste.

Moldy Taste.—The characteristic taste of mold. Wines easily contract this taste, either from moldy casks or from moldy grapes having been used. It is generally possible to take away this taste by the use of olive oil.

Sapore di tempesta, It.; *Saveur de grêle*, Fr.—A harsh, bitterish, somewhat moldy taste, perceived in wine made from grapes that have been injured by hail at the commencement of their ripening.

Rancid (*Rancido*, It.; *Rance*, Fr.).—"When the wine is swallowed, or whilst it is being drunk, a displeasing taste is noticed in the throat and slightly on the palate, almost analogous to that of rancid substances, from which comes the name given to this disease of wine, till now unstudied by any author. The *rance* can also be smelt, if it is pronounced, but a good nose is needed to discover it, and a delicate palate to taste it, at its incipiency."—O. Ottavi.

Fruity Taste[†] (*Sapore di frutto*, It.; *Saveur de fruit*, Fr.).—Many young wines, when well made, have a very pronounced taste of fruit.

Common wines, with age, lose this taste, but fine, and above all, the finest, wines retain it, much to their advantage; they retain it, however, only when aged slowly, and without the use of artificial aids.

Tartaric Fermentation.—This term is used to cover two different maladies of wine caused by two micro-organisms, which differ somewhat from each other, and the products of the fermentations caused by them differ considerably. These maladies, however, have a certain affinity, since both the micro-organisms, to whose action they are due, live at the expense of the tartaric acid in the cream of tartar.

The French distinguish these two maladies, calling the first "*la maladie de la pousse—vin poussé;*" in Italian, "*malattia del subbollimento;*" and the second, "*maladie de la tourne—vins tournés;*" in Italian, "*cercone.*"

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[*] It may perhaps be useful to note that the lees may become the seat of a bacteroid fermentation independently of any anterior disease in the wine. Thus, according to the experiments of Ravizza, the wine and lees may become the prey of bacteria without the aid of molds or other micro-organisms that destroy the acids.

The temperature most favorable to the development of bacteria in the lees seems to be from 77° F. to 86° F. Below 77° F. the phenomena accompanying the life of these bacteria decrease, and towards 50° F. cease altogether. The practice, then, in racking, of separating the last layers of wine, that is, the part lying in contact with the lees, from the rest is a good one, and this wine may be considered of inferior quality, either because it lacks a clean, fresh taste, or because it is sometimes cloudy.

[†] Fruity is very often used in English with the inappropriate meaning of somewhat sweet.—*Trans.*

"*Maladie de la pousse.*"—This disease is recognized by the wine spurting out when the vessel in which it has been confined is opened; the wine exercises a strong pressure on the staves of the cask on account of the carbonic acid which is formed; it is from this that comes the term "pousse."

In the glass the wine shows a persistent ring of small gaseous bubbles of a whitish color. If the wine is left exposed to the air it becomes turbid; its color becomes dull with a tendency to yellowish.

The wine has lost its primary flavor, and as the disease progresses, becomes more and more insipid; if it is shaken there is an appearance of silky waves at the surface, caused by the lees which has risen up.

Balard was the first to show the presence in "vins poussés" of a ferment which, according to him, resembles the lactic ferment. He has further shown that in these wines the quantity of volatile acids is increased, the one found in largest quantity being acetic acid.

Bechamp and Sténard have shown that propionic acid is formed in these wines from the tartar and the glycerine. Nicklés, on the contrary, is of the opinion that metacetic acid is produced.

Duclaux, who has given much attention to this malady, seems to have proved: (1) That the amount of free acids augments with the progress of the malady; (2) that this increase is made at the expense of the fixed acids of the wine, particularly of the tartaric acid; (3) that the acids formed are propionic and acetic. After having shown this he concludes by saying that all fermentation of the tartar that takes place with the evolution of pure carbonic acid and production of propionic and acetic acids should be called "*maladie de la pousse.*"

Cercone, *vin girato*, *mercuriella*, It.; *Tourné*, *vin tourné*, *vin qui a donné le tour*, Fr.).—At this word in an Italian dictionary is written: *Cercone*—a distiller's term—is said of a spoiled wine, because in becoming thus it works and turns; *vappa*, *lora* of the Latins. The *lora* of the Latins is certainly not the *cercone*, but *family wine*, *piquette;* neither is *vappa*, since that, according to the dictionaries, should indicate a flat, vapid wine. *Vappa vinum insipidum et nullino virtutis, postquam omnino odor saporque optimus evaporavit.*

Vin tourné has this peculiarity, that when first poured out it appears sound, but after a short time it tends to become turbid and iridescent.

Under the influence of the oxygen of the air the coloring matter becomes purplish, and precipitates, and the wine acquires a yellowish tint, a sour taste, and a forbidding bitterness.

Wines of this kind when distilled give a brandy having a bitter taste, caused probably by ammoniacal compounds. The alcohol made from them has not always, but often, a strong and pungent odor, and cannot, without being well rectified, be put to the ordinary uses of wine alcohol, that is, the manufacture of vermouth, etc. This odor is sometimes so pungent as to bring tears to the eyes, and, by fractional distillations, it is possible to isolate a certain quantity of croton-aldehyde.* This compound is formed, very probably, during the distillation by the condensation of the aldehyde with diminution of water.

Balard has found lactic acid in "vins tournés;" Glenard, on the other hand, has found potassic acetate. In the secondary fermentation of "vins tournés," there is a formation of acetic acid, and more especially of lactic and tartronic acids.

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* Recently Professor Comboni, in distilling a wine made by blending Marzemino and Black Pinot, which had been attacked by the bitter fermentation, found in the distillate a considerable amount of aldehyde and formic acid. These products are certainly formed during the progress of the secondary fermentation, for they are not found at all in the same wine when sound.

A wine attacked by this disease may be considered as lost; however, at the start it may be useful to try the addition of tannin and cream of tartar, then pasteurization and fining. The disease, if not arrested, is followed by putrid fermentation.

PUTRID FERMENTATION.—This disease attacks the organic matter in the wine, destroys it, and gives rise to repulsive tastes and odors.

In the incipiency of this fermentation, the repulsive odor and taste are not very marked, and a cure may be attempted by heavy sulphuring, followed by filtration through charcoal, which acts as a disinfectant.

FAT (*Grasso*, It.; *Gras*, Fr.).—I will say now that this defect should not be confounded with that of viscosity or greasiness, though at first view it might be supposed to be the same in a moderated form.

The defect of "fatness" is rarely found in generous wines, but is usually confined to weak ones, and is not due, like "greasiness," to a fermentation, but to the presence of a certain amount of albuminoid substances, of gum, mucilage, imperfect sugars, etc., which impart to the wine a character which, when it is tasted, leaves a more or less marked impression of something glutinous; an impression which persists for some time, leaving, as it were, a pasty feeling in the mouth.

"Fat" wines are indigestible, and hard to keep during the hot season, as they are extremely liable to secondary fermentations. The wines in which this defect is usually found, are those grown on moist plains, which are naturally fertile, or made so by the addition of nitrogenous manures, as, for instance, young vineyards where the effect of manuring at the planting of the vines has not worn off.

This defect may be avoided entirely, or to a great extent, by a thorough and prolonged aeration of the must, or by the addition of alcohol or tannin* to the wine.

Sometimes this defect, when not too pronounced, will partly or wholly disappear after the wine has gone through its slow spring fermentation.

GREASY, VISCOUS (*Filante*, *Grassume*, It.; *Filante*, *Graisse*, Fr.).—Terms used of a wine which has lost part of its fluidity and which, when poured into a glass, falls without noise, or like oil; it has that viscid, mucilaginous look which reminds one of white of egg.

This malady is caused by a micro-organism. A greasy wine, as the malady progresses, loses its fragrance and becomes bitterish; its color becomes dull and tends to turn brown; finally, it loses its natural transparency and brightness. At first it is flat, vapid, and distasteful; and finally, rancid and sour by the formation of lactic acid.

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*The addition of a little tanninized wine is better than the direct addition of tannin.

Tanninized wine may be prepared thus: Take a small cask, holding, for example, about 25 gallons; fill it with a strong wine, or one made so by the addition of 1 or 1¼ gallons of alcohol of 94° C.; into the wine put about 35 pounds of grape seeds which have not been fermented. For the first few days the wine should be stirred from time to time, and then left to itself. After about ten days the liquid part is drawn off, and is then a wine heavily charged with tannin, which serves excellently for the purpose above noted; for that purpose a dose of 1 or 2 gallons of the tanninized wine to 100 of the wine to be treated is about the right proportion.

If a tanninized wine is needed for the defecation of the must, it is prepared thus: Take 5 gallons of alcohol and 10 gallons of wine, put in a small cask, and add about 18 or 20 pounds of seeds, and treat as in the former case; 1 or 2 gallons of this is sufficient to thoroughly defecate 100 gallons of must.

If fresh seeds are not to be had, dry ones may be used, providing they are in good condition, that is to say, providing they have been dried in the shade, kept in a dry place, and have not become moldy.

This malady occurs oftener in white than in red wines; in late years, however, it has been found often in red wines on account of the unfavorable conditions for the grapes attaining a complete maturity, such, for instance, as the damages done by insects, cryptogams, and bad weather. It occurs easily, too, in red wines made from grapes grown on very fertile soil rich in albuminoid substances.

Very probably this deterioration is much more complex than is usually supposed.

Peligot was the first to establish the presence of a micro-organism, of a bacterium. Pasteur, later, demonstrated that this bacterium has the property of transforming the sugar that remains in the wine into a mucilaginous or viscid substance.[*]

Béchamp calls the active ferment of this process *Micrococcus viscosus*, and the gum which is formed *viscosio*.

Tannin and alcohol, in certain proportions, prevent the development and action of this bacterium; the conclusion, therefore, is that wines poor in alcohol and tannin, and containing sugar, are subject, especially if white, to become "filant." This explains also the use of tannin, as proposed by M. François, of Chalons, to arrest or prevent this malady.

François attributes this malady to a peculiar nitrogenous substance, gliandin, a kind of glutin, which seems to have the property of being precipitated by tannin. Nessler affirms, however, that we do not know yet how the tannin acts.

I have already remarked on the complex nature of the malady under discussion. Usually it is held to be owing to a lack or deficiency of tannin. This, however, is not invariably true, since Francisco Selmi has found it in wine made from Lambrusca grapes, and therefore rich in tannin. It seems that in this malady the tartaric acid also suffers changes. Probably on account of these changes Bizzari proposes the use of tartaric acid, 200 to 250 grammes per 100 gallons, as a cure or preventive of the malady.

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[*] The bacterium of "La Graisse" put into a solution of sugar containing albuminoid and mineral substances acts upon the sugar and transforms it into a kind of gum, mannite, water, and carbonic acid. Thus, 100 parts of cane sugar will give 50.09 parts of mannite, 43.5 of gum, besides water and carbonic acid.

Monoyer proposed to account for this transformation by two chemical equations, the first of which would give mannite and carbonic acid, the second gum and water, as formed from the glucose.

Schmidt-Mûlheim is about of the same opinion, he believing that the viscous fermentation consisted of two processes, the first of which gave mannite and carbonic acid, and the second the viscid substance.

Kramer has studied this ferment. He examined three wines afflicted by it, and besides *Saccharomyces ellipsoideus*, *Saccharomyces mycoderma*, etc., he found an extremely minute bacillus 2 to 6 μ long, and .6 to .8 μ thick. He failed to cultivate this bacillus on potato, agar agar, etc., but by putting a little of the infected wine into a new (three months) white sterilized wine and with 3 per cent of glucose, he found that the bacillus developed well and rendered the wine "filant," but only when the air was completely excluded by covering the wine with a layer of oil. With access of air there was very little development of the bacillus, and instead an increase of the other ferments of the wine. Kramer has called this ferment *Bacillus viscus vini*.

The peculiar kind of gum produced by the viscous fermentation of the sugar renders the wine viscid and glutinous. In its properties it resembles dextrine more than it does gum arabic.

The viscid substance, according to Kramer, appears to be a product of assimilation of the organism, whilst the carbonic acid and mannite, which are formed contemporaneously, are products of the fermentation; a constant proportion between the first and the last substances does not exist.

The bacillus multiplies very well in its own viscid product.

The gum can be isolated and purified by precipitation with alcohol, dissolving the precipitation with water, and re-precipitating with alcohol. Dried at 100° C., it forms a brown, amorphous body, which in water, without being dissolved, swells up greatly and forms a kind of glue. It has no acid reaction.

The best means of preventing or arresting the disease consists of the use of tannin, pasteurizing to destroy the bacteria, racking into sulphured casks, and finally the addition of alcohol to the wine.

Pasteurization is inapplicable in the case of white wines which are destined for the fabrication of champagne, because it not only destroys the bacteria, but also the alcoholic ferments, whose action is necessary to produce the carbonic acid, which renders the wine sparkling.

At the beginning of the development of the disease, forcible agitation of the wine will restore its clearness and fluidity by the disassociation of the bacteria and the dispersion of the mucilaginous matter which envelops the parasite.

Agitation, however, must not be looked upon as a curative measure; the results obtained are only temporary, for the cause of the disease, viz.: the bacterium, is neither destroyed nor removed.

FLAT, WINE FLOWERS (*Vino svanito*, *Svaporato*, *Fiorito*, It.; *Vin evanoui*, *Évaporé*, *Fleuri*, Fr.).—A wine becomes flat when it remains for some time exposed to the air, as happens in an imperfectly filled or badly bunged cask. In time it becomes covered with "wine flowers," which consists of the *Saccharomyces vini*, or *Mycoderma vini*. In either case the wine gradually acquires an unpleasant, somewhat bitterish taste, and loses its strength and bouquet by evaporation, or else the breaking up of the alcohol into water and carbonic acid. This has been called by some one, on account of the products formed, hydro-carbonic fermentation, and is caused by the *Mycoderma vini*, which attacks not only the alcohol, but very probably the ethers, succinic acid, and glycerine, as these bodies tend to disappear.

Although cases do occur in which generous wines are attacked by the *Mycoderma vini*, still it has a decided preference for young and feeble wines. In old and well-defecated wines it develops with difficulty, perhaps because in these wines the elements necessary for its nourishment (nitrogenous bodies and phosphates) are not found.

The practice of some wine makers with regard to "wine flowers" is not in accord with that of those who follow a rational system of wine making. They consider only the development of the "flowers," which they look upon almost as a preservative of the wine, whilst the others sustain the necessity of energetically combatting and preventing the increase of the "flowers," because it is not only dangerous in itself, but is almost always accompanied by the *Mycoderma aceti*, or *Diplococcus aceti*, which, the moment circumstances become favorable, commence to replace the *Mycoderma vini* and cause the acetification of the wine.

When it is thoroughly understood how the "flowers" act it is easy to explain the facts put forward by those who do not consider it dangerous, and also the reasons of those who believe that it should be prevented by all means, and destroyed on its first appearance.

The presence of the "flowers" causes such an absorption of oxygen and development of heat and carbonic acid, as to prevent the growth of any other organism.

Ducleaux has calculated that 80 grammes of alcohol contained in a litre of wine of 10 per cent, needs for its transformation into water and carbonic acid more than 160 grammes, or 100 litres of oxygen.

The conclusions to be drawn from this are evident; they are, that when the cask is well closed, so as to prevent the free entry of air, the diminution of alcohol, caused by the "flowers," is reduced to a mere trifle, and that the presence of the "flowers" excluded the action of other micro-organisms.

We must not, however, reason from this that the *Mycoderma vini* is really of use, for if exposure to the air should happen, if, instead of remaining white, the "flowers," as Pasteur noticed, should turn red, then, sooner or later, it will cede its place to other organisms, to the vinegar *diplococcus*, which, as I have shown before, is ready immediately to commence action, finding itself in favorable condition for its development, for the "flowers" itself serves for nutriment; and if there should be a considerable rise in temperature, the conditions are the best possible.

The final conclusion then, plainly is, that the "flowers" should be carefully guarded against; this is done by the strictest attention to "filling up," the importance of which was recognized by the poet Alemann, when he wrote:

Che nulla cosa
Può medicar il vin, che resta scemo.

The "flowers" may be destroyed by the addition of sulphurous anhydride or a few drops of alcohol.

With wine in bottles, the development of the "flowers" is prevented by keeping the bottles lying down; if instead the wine is kept in flasks ("*fiaschi*"), as in Tuscany, or in demijohns, a few drops of the purest olive oil on the surface of the wine will have the same effect.

Sour, Pricked, Acetified (*Vino che ha preso il fuoco*, *Lo spunto*, *La punta*, *Il portore*, *Vino acetoso*, It.; *Vin qui a pris le feu*, *l'Aigre*, Fr.).—Acetic acid is one of the normal components of wine. It is formed during the alcoholic fermentation, but in such minute quantities as to be imperceptible to the taste. When the proportion of this acid, from one of the many known causes, becomes large enough as to be perceptible, then the wine is said to be "pricked."

A pricked wine retains its natural color and limpidity.

This defect is recognized by the odor and taste of acetic acid; in tasting, its strongest effect is perceived at the base of the tongue.

If a wine thus affected is not taken in hand immediately (and in truth success is not always sure) and treated with heavy sulphurings or pasteurizing, it soon becomes sour and acetic.

Acetification is due to the action of a micro-organism, the bacterium known under the name of *Diplococcus aceti*, still commonly called *Mycoderma aceti*, which increases with a rapidity truly prodigious. Ducleaux tells us that if on a surface of wine a metre square an almost imperceptible amount of these bacteria is allowed to fall, in twenty-four hours the whole surface of the liquid will be covered with a layer of them so closely placed as to be crowded into contact. Thus, there will be three hundred thousand million individuals formed in twenty-four hours.

The rapidity with which the acetic bacterium multiplies explains why a pricked wine, when the temperature is favorable, becomes so quickly completely acetified.

It should be remembered that whilst it is easy to prevent this disease by taking proper precautions in the fermenting-room and cellar, it is difficult, if not impossible, to destroy it when started.

Once a wine has become pricked, instead of trying to effect a cure, it is better to follow the advice of Guyot, who says:

"When wine acquires the odor and taste of acetic acid, it is sent to the vinegar factory, but it is never attempted to use it as wine."

All the means that have been suggested for the treatment of a pricked wine may be considered as palliatives only, and not as radical cures. In this regard Carpené writes very justly:

"The neutralization of the acetic acid, which has developed in the wine by the oxidation of the alcohol with potash, soda, lime, magnesia, and their simple or double neutral carbonates and tartrates, seems to be a rational method, but, in reality, is not so. These substances neutralize wholly, or in part, the free, and even the combined acids, and the diminution of the complex acidity of the wine renders the acetic taste less noticeable, but does not completely remove it. To remove entirely the acetic acid it is necessary to completely neutralize the wine, because the acetic acid combines with the alkaline and earthy-alkaline bases after they have neutralized the tartaric, malic, and succinic acids. Moreover, acetic acid, even when completely combined with a base, gives out, though less strongly, its characteristic odor, so that even after complete neutralization the wine will still have an odor of acetic acid, accompanied besides by a bitter taste, which lingers in the throat, and may be worse than the first fault."

MILK-SOUR, LACTIC ACID.—This, by inexperienced tasters, is easily confounded with pricking or acetification.

A milk-sour wine has a more disgusting, biting, and penetrating acidity than an acetic wine, a harsh acidity, whose effect is felt long after the wine is swallowed. An acetic wine has a noticeable odor of vinegar, whilst a milk-sour wine emits an odor of rancid butter, due to the butyric acid which almost always accompanies lactic acid.

If there is any doubt as to which acid the wine contains, the doubt can be solved by pouring a drop or two of the wine into the palm of one hand, and then rubbing it with the other; if any acetic acid is present its odor will be immediately perceptible on the hands.

A milk-sour wine loses some of its fluidity, and its color becomes dull.

Sweet, badly defecated wines, especially those rich in albuminoids, are liable to milk-sourness.

The disease appears during the winter or in the spring, and generally in wines poor in acids; it is accompanied by a turbidity of the wine and a change of color. As long as the wine remains in full, well-bunged casks, this turbidity and change of color do not occur, but only when it is exposed to the air.

Some observers have considered lactic acid as one of the normal products of alcoholic fermentation, like glycerine, succinic acid, etc.; the truth, however, is, as Pasteur has proved, that whenever the smallest quantity or trace of lactic acid is found in wine it is caused by lactic fermentation.

Whenever the alcoholic fermentation of certain musts, rich in nitrogenous matters, is not well conducted, especially as regards temperature, a certain quantity of lactic acid is very easily formed, which is a bad defect. This happens generally in certain years in warm countries, where the so-called sweet-sour wines are produced.

It is difficult, not to say impossible, to take away the defect of milk-sourness; the different methods proposed, including that of refermentation, do not succeed; consequently, the best thing is to prevent it by a thorough defecation of the must, and a properly regulated fermentation, not allowing the temperature to rise to a point at which the alcoholic ferment becomes inactive, and thus preventing it from reducing all, or the major part, of the glucose contained in the must.

UNIVERSITY OF CALIFORNIA—COLLEGE OF AGRICULTURE.

AGRICULTURAL EXPERIMENT STATION.

REPORT

OF THE

VITICULTURAL WORK

DURING THE SEASONS 1887-93,

WITH

DATA REGARDING THE VINTAGES OF 1894-95.

Part I. *a.* Red-Wine Grapes (continued from Report of 1892).
b. White-Wine Grapes.
c. Raisin and Table Grapes.
Part II. Notes on Miscellaneous Subjects.

BEING A PART OF THE REPORT OF THE REGENTS OF THE UNIVERSITY.

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REPORT

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Professor of Agriculture and Director of the Experiment Station

TO THE

PRESIDENT OF THE UNIVERSITY.

UNIVERSITY EXPERIMENT STATION.

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1894-95.

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LETTER OF TRANSMITTAL.

President MARTIN KELLOGG:

I transmit herewith the report of viticultural work done since the last report was issued, up to and including the vintage of 1895, so far as the latter can at present be usefully reported upon; including, also, a summary report on the white-wine grapes under cultivation in California, and their wine-making qualities; being the continuation and conclusion of the report already published in 1892, on the red-wine grapes grown in the State.

The publication of this report has been purposely delayed, for the reason that the depression of the wine industry in the State, and the consequent lack of interest on the part of grape-growers, seemed to render such publication inexpedient for the time. Now that that industry is again becoming more profitable, and is likely to be placed upon a more rational basis than has been the case heretofore, it seems proper to place before those interested all the facts and results which may conduce to a better understanding both of the methods of wine-making, and of the materials employed therein. This seems the more appropriate since, by an Act passed at the last session of the Legislature, the technical work of the State Viticultural Commission was transferred to the College of Agriculture; thereby materially changing and enlarging the scope of the work to be prosecuted hereafter. Up to the time when this Act, and the appropriation accompanying it, became effective, the viticultural work of this department was necessarily almost wholly confined to the laboratory and office, as there were no funds available for traveling, and for field and winery experiments. Although the appropriation accompanying the Act of transfer is quite small (being only one fourth to one fifth of the amount annually expended by the late Viticultural Commission), it permits of sufficient expansion to change materially the scope of the work; and for this reason alone it seems proper to make a final report upon what was done on the old plan. That work has now progressed so far as to form a solid and definite basis of facts for guidance in the preparation of the several classes and grades of wines, by ascertaining experimentally, as well as chemically, the peculiarities of each variety of grapes cultivated on a commercial scale within the State. It is merely a question of time when, instead of the confusion thus far prevailing in the classification of California wines, conformity to the commercial standards recognized all over the world will be established. That, in order that this may be accomplished, the investigation of the fundamental qualities (including the chemical composition) of each variety of grapes is a prerequisite, hardly requires discussion.

It is high time that the haphazard methods even yet so commonly pursued in this State, should be discarded, and that the experience had, whether in the winery or in the laboratory, should be gathered into a definite form, as a guide to the rational wine-maker; so that hereafter California wines may appear on the world's market under their own labels, instead of being, as has heretofore been too largely the case, disguised under foreign ones, when of good quality; while the poorer qualities were sure to be placed upon the market with the true statement of their California origin. California wine-makers must now avail themselves of the rapid and important progress made in Europe, in the preparation of the best wines possible from a given material. They must, above all, avail themselves of what experience has been had in climates similar to ours, instead of attempting each one to pursue the method of his own country, no matter how different in climatic and soil conditions. It is high time that the pernicious axiom once promulgated to the public, that "any fool can make wine," should be discarded by the viticulturist for the conviction that wine-making is a technical branch requiring special knowledge of no mean order, particularly when the industry is pursued under new conditions, such as prevail in California; and that while the experience of their forefathers has enabled European peasant wine-makers to produce good wines by following a definite procedure in certain localities, it will not do for us to blindly follow their lead. As a matter of fact, the introduction of scientific methods in European wine-making has increased enormously the amount of good wines now available in the world's market; and if we want to compete with these, it will be necessary to avail ourselves of the same progressive methods.

A very notable improvement in the average quality of our wines has occurred within the last five or six years, and the high excellence of the product obtained in so many cases renders any further continuance of slipshod methods inexcusable. What has been done once can be done again; and, with the organization of grape-growers and wine-makers now happily effected, it is reasonably to be expected that pecuniary reward will follow the application of rational principles in wine-making. In that respect, the chemical work at this station has been very instructive, as will be seen from inspection of the tables. The same varieties in different localities, such as Mission San José on one hand and Tulare on the other, show so widely different composition as to render the same variety wholly unadapted to one place while eminently fitted for the other. It is now generally understood that the same grape-variety grown in hot southern localities increases in sugar and loses in acid, as compared with a northern one; but the *extent* to which this occurs varies exceedingly with different grapes. In some the variation is very slight; while in the case of others the deterioration of wine-making qualities becomes such as to wholly throw out of consideration some of the grapes most highly favored elsewhere. On the other hand, some varieties of which it was fully expected that they would prove deficient in wine-making qualities in the southern localities, have on the contrary proved remarkably successful. And this occurred with some varieties from which such behavior was wholly unexpected. It will therefore well repay the intelligent wine-maker who desires to plant a vineyard, or to graft over unsatisfactory vines, to study these results carefully.

Respectfully,

E. W. HILGARD,
Director.

THE COMPOSITION AND CLASSIFICATION OF GRAPES, MUSTS, AND WINES.

By E. W. HILGARD.

The report herewith submitted to the public, and more especially to the grape-growers and wine-makers of the State, may be considered as marking the termination, for the present, of systematic investigation of grape-varieties with respect to their composition and general wine-making qualities in the different regions of the State. The method and final object of this work is stated in former reports, but it seems not unnecessary to re-introduce the main portion of that statement by way of introduction and explanation:

> The plan adopted in this matter is in conformity with my view, shared by the best vintners in the State: that among the first necessities of the present situation of California wines in the world's market, is the establishment of more definite qualities and brands, resulting from a definite knowledge of the qualities of each of the prominent grape-varieties, and of their influence upon the kind and quality of the wine, in blending before, or, as the case may be, after fermentation; of the treatment required by each in the cellar, during the time of ripening; and finally, of the differences caused by difference of location, climate, etc., as well as by different treatment of the wines themselves.
>
> To this end, a definite knowledge of the character and special wine-making qualities of each kind of grape serving in the preparation of wine, is indispensable. In the wine-producing countries of Europe this knowledge has been acquired by long experience; and chemical investigation has subsequently in a great measure ascertained the natural conditions upon which the attainment of certain results in wine-making depends. The principles thus evolved can be applied to new conditions, such as those existing in California, and thus save to a great extent the laborious and costly experimenting which has been gone through heretofore, by formulating into generally intelligible rules the knowledge which otherwise usually remains the trade secret of a few experts.
>
> The first step to such knowledge is to obtain a definite idea of the material to be treated; and, curiously enough, however numerous are the analyses of ready-made European wines already on record, there are comparatively few cases in which the must from which they were produced was also investigated in so definite a manner as to lead to broad generalizations. Clearly, what is needed is that first the must, and then the corresponding wine of the more important grape-varieties, should be made the subject of detailed investigation, and that the wine should have been produced from the must under definite, or definitely varied conditions, with absolute certainty of the purity of materials, as well as of the precise manner of operating in each case. This cannot, as a rule, be depended upon in large wineries, where the exigencies of the supply, pressure of work and weather, the necessary employment of raw hands, and above all, the necessity of yielding to financial considerations, impose limitations and uncertainties that can but rarely be controlled at will. When this *can* be done, the large-scale experiments are of course by far the more decisive and cogent, and of the greatest practical value.
>
> In an experimental laboratory, the quantities operated upon are of necessity relatively small; and it is highly important that allowance be made for this circumstance, as well as for other points in which the "wholesale" practice must always differ from the small-scale one. For instance: the management of the temperature of the fermenting-room is easier in a large winery properly constructed than in a small experimental room and with small quantities of must, which are very quickly affected by changes of temperature such as would have remained unnoticed and without influence upon the great masses in the winery. This difficulty is very apparent in the record of the course of temperatures in fermentation.
>
> Nevertheless, we are thus enabled to obtain a very close estimate of the results obtainable from a given variety on the large scale, and of the part that each will play when blended either before or after fermentation. Few grape-varieties will, like the peerless Riesling, by themselves produce the best possible product. The art and science of blending is scarcely second in importance to the possession of good raw materials, soils, and climates; and while its last refinements depend upon a corresponding refinement of indi-

vidual taste and judgment, there is a large part of it that can be intelligibly codified, thus preventing a waste of good materials upon unmerchantable wines.

Even the most cursory consideration, however, shows that this cannot be the work of one or of even a few years; but, like all other agricultural experiences and experiments, must be extensively repeated in order to become the basis of general practice. The same grape-varieties grown in different localities and in different years will differ materially in their composition; and it is only by extended comparisons of these through a number of years that the accidentals can be definitely segregated from the essentials. Hasty generalizations, based upon limited experience, are the bane of all experimental work, especially in agriculture.

It should be fully understood and remembered that while peculiarities and defects shown by analysis are perfectly definite indications as to the conditions that *must* be fulfilled in a successful blend, yet analysis cannot as yet take cognizance of the delicate and almost intangible flavors or "bouquets," which must likewise be made to harmonize, in order to satisfy a cultivated palate. To that extent the determination of the proper blends must always remain with the expert wine-taster; but the work of the latter is immensely facilitated by being informed, through the analysis, of the prominent chemical peculiarities, which in any case must be taken into consideration, and which ordinarily are left to laborious and more or less blind guessing or experimenting.

To this method it has been somewhat captiously objected that, as the chemical composition is not the determining factor of the commercial value of wine, the chemical analysis of musts and wines cannot serve as a clew to the quality to be obtained. It has also been said that wines produced on the small experimental scale, which is the only one possible with the means at our command, are incapable of furnishing a definite clew to the results of vinification on the large scale.

These objections, however, are wholly untenable; they would, if correct, prove the inutility of laboratory work in all the great achievements of industrial progress upon which our modern life is based.

As a matter of fact, for the first six months there is practically *no* difference between wines made *by the same method and with the same care*, in large and small quantities. It is at that age that wines are mostly sold by the producer to the dealer. After that time the development of the wines in the small package is much more rapid, and therefore somewhat different from that of the large one; the small package is also more difficult to handle and care for, and in a *winery* will usually soon pass beyond control. In an experimental cellar, where special and close supervision is given, a closer approximation to large-scale results is possible, and as our record abundantly shows, wines can there be carried to maturity, and their essential general qualities satisfactorily observed. When a good, mature wine has been made on the small scale, it is indisputable that the same can be done in the winery, and probably with greater ease. If, on the other hand, the result should be unsatisfactory, the nature of the particular difficulties in the way of success can be determined and verified, so as to forewarn the large-scale producer of their nature, and suggest the precautions to be used in avoiding them.

It is idle to pretend that such results are of no practical value. They have been again and again verified afterward in winery practice; and but for them, we would still be in dense ignorance of the essential features of most of the grape-varieties now growing in the State, when grown in different climatic regions. Moreover, of a large number of varieties here reported upon, only small experimental quantities were and still are available; so that their treatment on a small and inexpensive scale was the only possible mode of obtaining *any* information regarding them. To wait until some one should think of cultivating and testing them on the large scale would be to omit to do precisely that for which experiment stations have been established the world over; namely, to obtain probable indications of what are *likely* to be the results of large-scale practice, so as to prevent the useless expenditure of labor and money upon costly large-scale trials at haphazard.

As a *reductio ad absurdum*, it has been proposed to establish, on the part of the State, a large experimental vineyard and winery, where such experiments could be made on a "practical" scale. Aside from the enormous expense of creating, maintaining, and properly working even *one* such establishment, and the rather unsatisfactory experience had with much less difficult and complex work undertaken at State expense, it is abundantly obvious that unless several of them were created, or else the grapes were shipped by the carload to great distances from the extreme ends of the State, only a very limited region could be benefited by the enterprise, which would quickly collapse of its own cumbrous weight. No other grape-growing country has thought it necessary to burden the public purse with any such extravagant arrangement.

As to the cogency of chemical work: It is perfectly understood that certain conditions of chemical compositions *must* be fulfilled to render possible the production of certain kinds of wine at all; and while the exact quality and kind of the aroma to be produced cannot be thus foretold, it is absolutely certain that in the *absence* of such chemical conditions certain desirable qualities will invariably be found lacking. Thus, it is universally understood that a certain minimum of acidity is required in a must in order to obtain a sound and complete fermentation, and that a certain class of aromas are indispensably dependent upon the presence of such acids in adequate amounts. Hence the quantitative determination of these acids alone is invaluable in forming a judgment of the best use to be made of different kinds of grapes, whether in blending in the vat, or in blending the wine after fermentation. This is so true that when the acids are known to be insufficient they are often added at heavy expense by the purchase of tartaric acid, in order to secure a good fermentation and a high flavor. Even unripe grapes are sometimes added to the fermenting-vat for the purpose of supplying this acid without such expense.

It has also been alleged that the taste of expert tasters is a better guide to the acidity and astringency in wine than is chemical analysis. But in the presence of sugar or much tannin, the best expert taster will often find himself completely at a loss as regards the real amount of acid present, and he will make grievous mistakes in blending, whether before or after fermentation. Yet this proper proportion in blending in the vat frequently cannot be remedied to advantage after the wine is made. In the best case, the blender will be wasting time by laborious and random trial of various blends, to which a knowledge of the chemical composition would have given him a direct clew.

In the case of Clarets, their distinctive quality of allowing a considerable dilution with water without disturbing the proper proportion of the tannin and acids, rests wholly upon the fact that acid and tannin must stand to each other within definite limits of proportion, beyond which no Claret capable of standing the dilution test can be produced. Other wines, such as Burgundies, are never expected to be diluted with water; a very slight addition of such will surely destroy its character, as the apparent proportion between acid and tannin changes completely after such a wine is diluted. This quality also, then, is entirely dependent upon certain amounts of, and proportions between, acid and tannin, of which by chemical analysis we readily ascertain the existence or absence, whether in the grape or in the wine.

So, also, the qualities of "body," smoothness, and others, are largely dependent upon certain definitely ascertainable chemical data. The keeping qualities, likewise, are largely conditioned upon chemically ascertainable conditions. It is thus obvious that in a new country like California, in which the specific wine-making qualities of most of the various grapes grown in the State are as yet unknown quantities, the determination of their chemical peculiarities can render the most essential practical service to the wine-maker, whether in determining the best adaptation of varieties already planted, or in the selection of those best adapted to his locality and purposes.

The time will doubtless come when some special type or types of wine, resulting from peculiar climatic conditions, and the multiplicity of grape types introduced, will be developed in California. But the time for this has hardly come as yet; the most pressing need now is to find a market for our wines, and to that end the most direct path lies through measurable conformity to established commercial types and qualities; based, not upon mere nominal imitation of the blends of varieties thus used in Europe, but upon an actual knowledge of what our climatic and soil conditions have made of those varieties, and how we can treat and blend them in order to conform to the established tastes of the world.

CLASSIFICATION AND TYPES.

Classification of Wines.—The commercially established classification of wines, as it exists in the European wine-making countries, must for the present at least, naturally guide California wine-producers also, as far as possible, if they desire their share of the world's commerce. To some extent it has been done in a tentative way heretofore; we hear of Bordeaux or Claret, of Burgundy, Riesling, and Sauterne, as well as of Port, Sherry, and Madeira. But if we examine somewhat critically, or sometimes even quite superficially, a great many of the wines sold under certain denominations, we find striking and almost ludicrous discrepancies between their character and that which is understood by the same name in Europe. One designation which has been used with reasonable correctness is Claret or Bordeaux wine; these are dry wines of rather high or medium acidity and tannin contents, which at the same time *will bear dilution with water* without disturbing the palatable ratio between acid and tannin. But when we come to the various California wines sold under the name of Burgundy, we find included therein such an utterly discrepant medley of different types, that the only possible definition at the present time seems to be "a red wine that will not bear dilution with water without losing its character"; and even this distinction is far from being always maintained. Thus, one sample sent to this laboratory for examination under the name of Burgundy, showed not less than 8 promille of acid and 4½ promille of tannin; it was, therefore, a highly acid and tannic wine, unsuitable for direct consumption, and belonging most decidedly to the Claret type of blending material. Then, at the same time, other samples come to us, approaching much more nearly the true character of Burgundy wines; namely, having a low proportion of acid and very light tannin, and incapable of resisting even a slight dilution with water without losing their zest, and of a red or orange-red tint of very slight intensity. Such wines approach more closely the type of the French Burgundy; but how can it be expected that any one ordering a "Burgundy" wine, and expecting something similar to what is so called in French commerce, should be satisfied with a wine of high acidity and astringency, such as that mentioned above, which stands on the opposite end of the scale from the true Burgundies? The term is now widely used in this indefinite manner by growers and wine-merchants; but it seems of the highest importance that this mischievous misnomer should be discontinued as early as possible, by all who are interested in the good name in the commercial world, of California wines and wine-makers. No doubt the failure of the characteristic grape of Burgundy (the Pinot) to yield satisfactory crops and wine-making results in California, is responsible to a large extent for the confusion that has arisen in regard to the Burgundy type. As the Pinots are characterized by low acid, high sugar, and low color, other grapes possessing similar characteristics, and sometimes grapes not possessing any of them, were included within the group; and thus we find in different vineyards seven or eight varieties growing under the name of Burgundy. Such varieties are Chauché noir, Trousseau, Robin noir, Cinsaut, and several others; the visible characters of these grapes differ so widely from that of the Pinot group proper that it was evidently only the superficial similarity of the *wine* that has led to the misnomer. Unfortunately, the designation has been extended to one important grape, the so-called Crabb's Burgundy, now recognized as being identical with the Refosco of northern Italy; an excellent wine-making grape, approaching the Claret type, and especially useful in that connection. This is probably the most mischievous of the misnomers of Californian nomenclature, as it causes the largest disappointment to those who order California wines for their own consumption, under the supposition that the type is measurably true to the French one.

Of other commercial classes of wine, the Sauterne type is probably the one that has adhered most closely to the typical grape product of the Gironde; largely because, naturally, the California climate is better adapted to the production of the Sauterne than of the Rhenish type of white wines. The latter class is here largely comprehended under the term "Riesling," which has been indifferently applied to almost any white wine, of whatever flavor, that possesses a high degree of acid, no matter how heavy its body, and how unlike the true Rhenish type.

Now, it is useless to attempt to ignore the fact that the California climate is particularly ill adapted to the reproduction of the kinds of wine which are produced near the northern limit of wine production in Europe. It is only in locations close to the coast, and protected from the warm rays of the summer sun, that anything similar to the true Rhenish type can be expected to be produced in California; it is idle to expect that anything properly resembling the Rhenish wines can be produced in the hot *valleys* of the Coast Range, from the same grape that produces it in the old country. The hill country of the coast ranges has done much better. It was at one time thought that the higher locations in the Sierra Nevada foothills also might produce such wine; but experience has shown that, on the contrary, the western Sierra slope is more specially adapted to wines corresponding to those of the south of Europe than to anything resembling those of the Rhine and the Moselle. In order that these types may be imitated with any degree of accuracy, new blends must be devised and different characters of grapes used, specially qualified *here* to form such wines, to which the flavor of the noble Riesling is imparted by an adequate blend. The use of the so-called Burger in this connection has, in the Napa, Sonoma, and Santa Clara valleys, proven measurably satisfactory; but there are other varieties, as yet but little cultivated, which will render similar and perhaps even superior services.

In European publications and ampelographies, the grape-varieties, if classified at all, are usually arranged in accordance with their botanical resemblances. But for practical purposes it is much better and more rational to classify them, as nearly as may be, *according to their wine-making qualities*, and their practical value for the grape-grower and wine-maker. That such a classification can, even in the best case, be only approximately correct and consistent, is a matter of course; not only because, according to the method of treatment, different wines may be made from the same grape in the same locality, but more usually because the same grape in a *different* locality may, in its wine-making qualities, belong to a totally different class. Thus the Carignane forms an acceptable material as a Claret grape in the Santa Clara Valley and other northern portions of the State; while at Fresno and southward, the character of the Carignane is wholly changed, as it loses both color and acid and can only serve as a blend with other grapes of the Southern French type. The classification given below can, therefore, be considered only as approximate, as it must, in most cases, be materially modified according to the location in which the grape is grown.

Among the white grapes the "Burger"* is a notable example of a totally changed type when grown farther southward; for at Fresno its wine assumes much more nearly the character of a Sauterne, so that no one conversant with the wines made by this grape in the Napa and Sonoma valleys would ever suspect that it was the same variety that produces good dry white wines in the Fresno and Tulare regions. The Burger certainly belongs to the southern regions of Europe, and seems to be at its best in the warm valleys of the interior of the State. The Zinfandel also shows a remarkable change from Napa to Fresno, as is shown in the following little table:

	Alcohol.	Acid.	Tannin.	Body.
Zinfandel, second crop; average of northern localities	10.6	.70	.060	2.4
Zinfandel, second crop; average of Fresno	12.5	.55	.255	3.0

The Fresno second crop is almost precisely of the same composition as the first crop at the north, and makes a fairly good dry wine; while the Fresno first crop makes an inferior product, mostly only fit for the still.

Many similar examples might be given; but this may suffice to show the necessity of *testing one and the same grape in different localities* before we can fully recognize its qualities for wine-making purposes. These examples emphasize strongly the need of experimental stations in the different portions of the State, where such experimental growths can be made systematically, and independently of local private interests that might be involved in the results; which will obviate the need of costly experimentation by growers themselves, by informing them beforehand how best to attain the end they may have in view.

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*The true Burger of Germany is a wholly different grape.

Enumeration and Definition of Types.—Below is given a summary characterization of the chief types of commercial wines, with a view of the composition of commercial samples of the same, from European analyses; together with a list of the chief grape-varieties producing them, and a brief discussion of the differences observed in the same grapes and types in California, in our investigations, as well as by intelligent growers. It is one of the objects of this presentation of the subject in condensed and systematic form, to bring out the experience of growers in different portions of the State with respect to the nature of the grapes and wines in their districts. It is fully expected that some will disagree with the classification here given, in accordance with their local experience; and all such facts and data will be welcomed as an addition to the stock of observation yet required to place the production of California wines upon a thoroughly rational basis.

In the list of principal varieties under each type, those which in some localities have shown qualities that would entitle them to a place in another type, are indicated by italics.

RED-WINE TYPES.

Bordeaux or Claret Type.

Characteristics.—Medium alcohol, acid, tannin, and body; good, violet-red color; fresh taste, and full vinous flavor.

Principal Varieties.—Cabernet Sauvignon, Cabernet Franc, Verdot, Merlot, Malbeck, Teinturier, Gamai Teinturier, Charbono, *Tannat*, *St. Macaire*.

Composition. (According to the analyses of European commercial Medocs.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Maximum	11.5%	.70%	.200%	2.7%
Minimum	8.5	.45	.150	2.0
Average	10.5	.58	.175	2.3

Our California wines, made from the several Medoc or Bordeaux red-wine varieties, differ notably in composition from the average given above. While the acid content is nearly the same as in French wines, these are almost, without exception, heavier in alcohol and body. The most marked difference, however, is in the tannin, which is generally double, and often three times as high in the California as in the commercial French wines of this type. This does not necessarily mean that so great a change has been wrought in the nature of the grape, but more probably that the French wine-makers and wine-blenders adapt the composition to the tastes of their countrymen, and of the world at large.

The St. Macaire is placed here because of its origin in the Bordeaux district, and of its being used as a blend with Medoc wines. The character of its wine, however, would, in most cases, place it by the side of the Petit Bouschet in the Southern French type.

Rhenish Type—Red.

Characteristics.—Very nearly related to the Bordeaux type as regards the high-class wines, especially the Affenthaler. The common red wines are mostly quite light-colored.

Principal Varieties.—Affenthaler, Arbst, Blauer Burgunder.*

Composition. (According to König, of Germany.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Common wines—				
Maximum	11.00%	.70%	.250%	3.0%
Minimum	8.00	.40	.100	2.4
Average	9.70	.53	.175	2.7
Auslese wines—				
Maximum	14.00	.66	.250	4.0
Minimum	10.00	.43	.100	2.4
Average	12.50	.50	.158	3.0

The Affenthaler has in California given wines resembling in composition the most prized red wines of Germany. They have, however, more tannin than the commercial wines, and do not retain a remnant of sugar, which is often found in the German *auslese* wines to the extent of 0.25% to 0.50%; being then made from overripe, selected berries. Common red wines of Germany are largely made from the Frankenthaler or Trollinger (Black Hamburg) in conjunction with Arbst, Blauer Burgunder, and others, often blended with whites, and therefore quite light-colored.

Burgundy Type.

Characteristics.—Alcohol, body, and acid medium; astringency low; color light and tending to the orange-reds; very smooth, agreeable wines, without special aroma, but developing a fine bouquet with age.

Principal Varieties.—Pinot noir (Blauer Burgunder), Pinot de Pernand, Meunier, Gamai noir.

The Pinots in California have almost uniformly produced wines heavier in alcohol, tannin, and body, and lower in acid, than the ordinary commercial wines of the Côte d'Or. The Pinot wines of the Burgundy district vary considerably in alcoholic contents, however, according to season and location. The best have on the average 11% to 12% of alcohol by volume, though in certain years wines with 13% to 14% are produced. The wines of the plains, made principally from the Gamai noir, are much lighter in alcohol, ranging down from 11% to 8%, and sometimes lower. The average composition of Burgundy wines, according to König, Bedel, and others, is about 10.3% of alcohol, 0.6% of acid, and 2.4% of body; tannin not determined. This average doubtless includes wines both of the "Côtes" and of the plains; those of the hills having a heavy body and high alcohol. The Burgundies depend more on their peculiar smoothness, flavor, bouquet, and appearance for their distinctive character than on their alcoholic contents, which is a very variable quantity. Unlike the Bordeaux or Claret wines, dilution with even a little water destroys their zest.

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* Properly a Pinot, Burgundy type, but much used in blending.

Jura Type.

Characteristics.—Full alcohol, tannin, and body; deep color; very solid wines, with less natural aroma than those of the Medoc.

Principal Varieties.—Sirah, Mondeuse, César, Etraire de l'Adhui, Tinta Valdepeñas, and Persan.

Composition. (According to California analyses.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Maximum	13.0%	.70%	.350%	4.0%
Minimum	10.0	.45	.200	2.5
Average	12.0	.55	.250	3.0

These show a close approximation to the composition of the Bordeaux varieties as grown in California.

The table of the chemical composition of this type as given above is calculated on analyses of California wines made from Sirah and Mondeuse. The other varieties are included in the type, because they usually make wines similar in character to the above. The Tannat in some localities should be classed with this type.

Southern French Type.

Characteristics.—Alcohol, acid, tannin, and body below medium; color generally tending to orange-red; mostly thin, neutral blending wines.

Principal Varieties.—(*a*) Color light: Aramon, Cinsaut, Grenache, Ploussard, Trousseau, Bastardo, Dolcetto; (*b*) Color light or dark, according to locality: *Carignane*, *Mataro*, Piquepoul, Mourastel; (*c*) Color dark: ***Beclan***, ***Petit Bouschet***, ***Alicante Bouschet.***

Composition. (According to European analyses.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Maximum	12.0%	.75%	.200%	2.5%
Minimum	8.0	.40	.100	1.8
Average	10.5	.53	.150	2.1

The wines which are taken as typical of this region are those of the plains of the Herault. Wines of somewhat higher character are made in favorable localities, especially in hilly districts, from the same varieties. The same is true in California, where the Carignane, Beclan, Mataro, and even the Bouschets will in some locations make excellent wines approaching the Jura type.

North Italian Type.

Characteristics.—Alcohol full to high, acid high, tannin medium, body full; color (except in the case of the Nebbiolo) deep, mostly violet-red; wines very rough at first, and slow to mature.

Principal Varieties.—Nebbiolo, Barbera, Bonarda, Fresa, Croetto, Favorita, Tadone, Refosco, Neiretta, Marzemino, Lagrain, Gros Mansenc.

Composition. (According to Italian analyses.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Piedmont—				
Maximum	14.5%	1.00%	.270%	3.2%
Minimum	11.0	.60	.150	2.0
Average	12.0	.80	.220	2.7
Venetia—				
Maximum	11.5	1.20	....	3.0
Minimum	8.5	.80	....	2.3
Average	10.0	1.10	.210	2.7

This type is divided into two groups: that of the wines of the northwest, typified by those of Asti, and that of the country of the lower Po. The latter, being to a large extent grown in plains and made from the acid Refosco, are lower in alcohol and generally thinner and even more acid than the wines of Asti.

There is another type of wine made on the plains of the Po from such grapes as the Dolcetto. They are smooth wines, of little character, used for blending or for early consumption, and resemble the wine of the southern French plains.

The Piedmontese grapes have maintained their characteristics remarkably in California, showing their special adaptation to our conditions. The grapes of the eastern part of northern Italy, the Refosco, Neiretta, Marzemino, though maintaining their high acidity here, have produced more alcoholic wines than they are generally credited with in Venetia. Of the commoner, heavy-bearing varieties of this type, only the Fresa has been tested to any extent. It maintains the characteristic (strawberry) flavor which has suggested its name.

It would thus seem that the grapes of this very pronounced type, which combines in a remarkable degree the properties of high acidity and high saccharine strength, are likely to render important services to the wine industry in this State, especially in its southern portion, where the diminution of acid jeopardizes, or renders impossible, the production of sound and high-flavored wines with the varieties now in general culture.

Austrian and Hungarian Type—Red.

Characteristics.—Alcohol and body medium, acid full, tannin below medium; mostly deep colored, light, quickly maturing wines.

Principal Varieties.—Kadarkas, Grossblaue, Blue Portuguese, Zinfandel.

Composition. (According to European analyses.)

	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Body.
Maximum	13.5%	1.00%	.280%	3.4%
Minimum	8.0	.50	.060	1.4
Average	11.3	.67	.150	2.5

The marked special flavor of the Zinfandel distinguishes it from the other members of this group, but on the whole it is best classed with this somewhat miscellaneous group. Some of the most valuable of the red-wine varieties of southern Austria are placed in the North Italian group, on account of their close resemblance to the grapes of the valley of the Po.

WHITE-WINE TYPES.

Rhenish Type—White.

Characteristics.—(*a*) Common wines: Alcohol low, acid high, body medium to low; clean, fresh-tasting, but neutral wines; (*b*) High-class wines: Alcohol, acid, and body medium, sometimes low; extremely fresh-tasting and aromatic.

Principal Varieties.—White ("Johannisberg") Riesling, Franken Riesling, Traminer, Ruländer, Orleans (Orleans Riesling of California), Kleinberger, Elbling, white and blue.

Composition. (According to König.)

	Alcohol by Volume.	Acid as Tartaric.	Body.
Common and Moselle wines—			
Maximum	8.50%	1.30%	3.00%
Minimum	6.00	.70	1.80
Average	7.30	1.00	2.30
High-class Rhine wines—			
Maximum	12.00	1.00	3.00
Minimum	10.00	.40	1.80
Average	11.50	.50	2.50

The finest and most renowned of these wines are mostly made of the White (Johannisberg) Riesling and Traminer. The Zierfahndler and Ruländer make less aromatic wines, while the neutral blending wines of Franconia are made principally from Franken Riesling and Gutedel (Chasselas). None of the Rhenish grapes make, in California, wines at all approaching in character the common wines of the banks of the Rhine and its tributaries. The Rieslings in some localities make wines of similar composition to that of the finer Rhine wines, but these usually lack freshness and attain too large an amount of alcohol. The Traminer, Ruländer, and Zierfahndler almost always contain too much sugar for complete fermentation. The Gutedel (Chasselas) in some places makes a smooth, neutral wine of moderate alcoholic strength, but it is generally lower in acid here than in Germany, and for that reason this variety has been grouped with the Southern French type, it being derived from that region.

The wines of the Moselle, peculiar for their high aroma, associated with high acid and extremely low alcohol (6% to 8%), are mostly made from the Rieslings.

Burgundy Type—White.

Characteristics.—The white wines of the Burgundy district are of similar character to the red, but are in general more alcoholic. The white wines of the red and white Pinots range in alcoholic contents from 11% to 14%, and even as high as 15%. The white wines of the Gamais vary from 9% to 10% of alcohol, and are used principally for blending. They serve for cutting with the more alcoholic Pinot wines to make a standard blend of 11% to 12% of alcohol for the manufacture of champagnes.

Principal Varieties.—Pinot Chardonay, Pinot blanc, *Franc Pinot*, Gamai blanc, and *Gamai noir*.

Sauterne Type.

Characteristics.—(*a*) Hauts Sauternes: Alcohol and body high; smooth, aromatic, liquorous wines, slightly sweet; (*b*) Graves: Lighter and drier wines, with less aroma.

Principal Varieties.—Semillon, Sauvignon blanc, Muscadelle de Bordelais, Sauvignon vert, Folle blanche.

Composition. (According to European analyses.)

	Alcohol by Volume.	Acid as Tartaric.	Body.
Hauts Sauternes—			
Maximum	15.50%	.75%	3.6%
Minimum	12.00	.65	3.2
Average	13.50	.70	3.4
Graves—			
Maximum	12.30	.71	----
Minimum	11.20	.54	----
Average	11.50	.63	2.0

The analyses of our California Sauternes show lower acidity than is indicated by available analyses for French Sauternes. The composition of the naturally fermented wines in general show a closer resemblance to the white wines of the Graves than to the Hauts Sauternes. The above figures for body show that the profuse amount of sugar allowed in some California Sauternes is not at all in accordance with the composition of the French prototype, which cannot much exceed 1% of unfermented sugar.

Southern French Type—White.

Characteristics.—(*a*) Wines of the plains: Alcohol and body low, acid medium; thin, neutral wines; (*b*) Wines of the hills: Alcohol and body higher; smoother, and more solid wines, but with little character.

Principal Varieties.—Clairette blanche, Marsanne, Roussanne, Verdal (Aspiran blanc and rouge), Chauché gris, Ugni blanc, Chasselas, Listan, *Aramon*.

There is really no distinctive type of white wine peculiar to southern France, though there are certain varieties of grapes characteristic of the region. The white wines of the south of France may be divided into three classes: (*a*) The common wines of the plains, having from 9.5%

to 12% of alcohol by volume, and made principally from Terret, Piquepoul, and Aramon; (*b*) The finer dry white wines, such as Picardans, grown on higher ground, having from 11.0% to 16.0% (average 13.5%) of alcohol by volume, and produced principally by the Clairette blanche; (*c*) The sweet Picardans, Muscats, Roussillon, and other "vins de liqueur." The last class is the most renowned, but the varieties which produce it are not included here, as they have been placed in the liqueur wine group.

For the purpose of the present arrangement the first two classes are considered as forming the white Southern French type. The high alcoholic strength found in some wines of this class is due to a light fortification which is given to some, even of the dry wines.

Austrian and Hungarian Group—White.

Characteristics.—The dry white wines of Austro-Hungary are so diverse that it is difficult to include them in one type. They should more properly be divided into four sub-groups:

1. Fine wines made from the best Rhenish grapes; somewhat heavier and less aromatic than the Rheingau wines.
2. Good table wines, alcohol and acid full, body light. Principal varieties: Wälschriesling, White Velteliner, Rothgipfler, Zierfahndler, Peverella, Furmint, Vernaccia.
3. Lighter table and blending wines, low in alcohol, smooth and clean-tasting. Principal varieties: Rother Steinschiller, Slancamenka, Bakator.
4. Thin, poor wines, low in alcohol and very high in acid, made from heavy-bearing varieties, the principal of which is the Heunisch.

Composition. (According to Austrian analyses.)

		Alcohol by Volume.	Acid as Tartaric.	Body.
1.	Average	12.00%	.60%	2.3%
2.	Maximum	13.00	.80	----
	Minimum	11.00	.50	----
	Average	12.00	.65	2.0
3.	Average	10.00	.55	----
4.	Average	9.00	.85	----

The grapes of the second and third classes are included in this group. Those of the first class have been discussed with the Rhenish type. Those of the fourth class are undesirable, and have never been tried in California.

A comparison of the above data with the detailed data regarding the composition of the wines of the various grapes in the different localities of this State, will render the intelligent grape-grower and wine-maker an important service in making up proper selections of grapes for his particular locality, or purpose, as the case may be. If more European analyses of wines made from a *single* grape-variety were available, it would doubtless be found that their composition of musts and wines agrees much more closely between Europe and California than now appears from the comparison of the commercial types with our analyses. But, with the single exception of the high-class Riesling wine, all European wines are blends of several varieties, adapted to the taste of the consumers for whom they are destined. Moreover, but very few of the named wines usually sold in California approach with any degree of closeness to their European prototype; for these are, almost throughout, the product of a judicious blending process, which as yet has been very imperfectly developed in California. For, with us, wines have mostly been named more according to the grape of which they are produced; or, if blended, the blend has been guided merely by taste, and that frequently by one not of the most practiced kind. High alcohol, high body, high tannin, have in the past been chiefly spoken of as the desiderata in this State; so that, in fact, until within the last few years the valuation has actually been based largely on the alcohol percentage alone. With such methods of procedure, both in vinification and in blending, it is no wonder that, even where the quality of wine has been good or excellent, constancy of character has been almost unattainable.

I am convinced that, with the proper understanding and utilization of the data given in this report, much of the uncertainty and haphazard heretofore prevailing will disappear, and that both in the selection of the grape-varieties to be planted, and of the proper blends to be made for particular purposes and types, the data imparted by analyses and the records of vinification will be found of the greatest practical use.

PART I.

Investigations of Various Types of Grapes, their Adaptability to Different Localities, and their Value for Wine-Making and Other Purposes; Made During the Seasons of 1887–1894.

By F. T. Bioletti.

Analyses of Musts and Wines.

Made by George E. Colby.

SPECIAL VITICULTURAL STATIONS (under private auspices) that have supplied material for the work here reported:

***West Side Santa Clara Valley Station**; Cupertino, Santa Clara County. John T. Doyle, Patron; Menlo Park.

East Side Santa Clara Valley Station; Mission San José, Alameda County. John Gallegos, Patron; Mission San José.

***Fresno Station**; Fresno City, Fresno County. E. B. Rogers, Patron; Fresno.

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* Discontinued.

DESCRIPTION OF GRAPES RECEIVED AND WINES MADE, WITH ANALYSES OF MUSTS AND WINES.

NOTE.—The classification of grapes and wines here given is made for convenience of reference, in accordance with the most usual or most prominent characters; but of course is not absolute, since one and the same grape may, according to climate, location, and treatment, be made to yield a great variety of wines.

The descriptions of a number of the grape types and varieties originally prepared by Prof. Hilgard for former reports, have, for the most part, been materially increased and rewritten by Mr. Bioletti.

[It will be noticed that in many cases the sugar in the must is higher than the "solid contents by spindle." The error is in the latter determination for the condition, of the must has much to do with the accuracy of the spindle. If in a "mushy" state, the instrument fails to reach its proper level, even on repeated trials, and even when the must has been strained. Filtering is too slow a process and is not practiced in the wineries. In the tables of analyses given in this report, when such discrepancies appear, the sugar test must be regarded as the more reliable.

When grapes are received for examination, it sometimes happens that they are in a partially dried condition, with some of the sugar in a crystallized form. This sugar would, of course, pass into solution in the fermenting-tank; but in the sample taken for the must analysis, some of it would remain undissolved and be lost from the determination of "sugar by copper." The wine would, in such cases, show a greater amount of alcohol than apparently called for by the sugar in the must. Such discrepancies also appear in the tables of analyses, and are to be thus accounted for. (Geo. E. Colby.)]

A. RED-WINE GRAPES.

(Continued from the Report of 1892.)

BORDEAUX, OR CLARET, TYPE.

(For other matters regarding these wines, refer to Vit. Rept. 1887-89, pp. 31-38.)

The production of good, light, clean-tasting table wines has made great progress in California in late years, and among our finer wines of this type it is not hard to find many which have a close and creditable resemblance to the better Medocs. Unfortunately, however, there is still too much wine which aims at the reproduction of this type, but which fails by reason of its harshness, its headiness, its lack of freshness, or its green and undeveloped taste. Wines made from Medoc varieties grown in the most favorable localities are apt to be too rich in the ingredients of good Clarets; they have too much color, too much tannin, too much alcohol, and occasionally too much acid. In fact, they contain all the essentials of good wine, but in too concentrated a form.

It is certainly an improvement to dilute these wines in the making, with a judicious amount of pure water, but this diminishes the body, flavor, and vinosity, and is incompatible with the best results. For commoner wines, the practice of picking the grapes when they show a certain percentage of sugar, say 22%, is occasionally found useful, but if this rule is followed the grapes will often be gathered before maturity, and the resulting wine will be thin, harsh, and green, and lack the fullness and aroma of a fine wine. The best method is to gather the grapes at perfect maturity and blend them in the fermenting-vat, or as soon as possible, with the product of some sound, neutral grape, such as the Aramon, which will dilute their sugar, color, and astringency without injuring their flavor and vinosity. To avoid the extraction of too much color or tannin, an obvious and rational way is to draw the wine off the pomace at the right time—that is, when the desired amount of color and astringency has been extracted. This, with the rich Medoc varieties, will be before the sugar has disappeared, and if care be taken to maintain the proper temperature, there need be no dangerous check of fermentation. It is the practice with some of the best wine-makers to press wines of this type when they show as high as from 8% to 10% of solid contents by the saccharometer. This insures a smooth wine, not too rich in color or tannin, the effect being especially noticeable in the latter ingredient. Drawing off too early must, however, be avoided, or the wine will be flat and lacking in astringency. The pomace, when this early pressing is adopted, contains a large amount of color, tannin, and aromatic principles, which make it very valuable for use in the manufacture of good piquettes or even blending wines.

A slow, cool fermentation is also of great effect in avoiding the harshness which these wines are apt to develop. This is well illustrated by the experience of the Algerian wine-makers, who, since the use of refrigerators has become general, are enabled to produce wines which, after some slight blending and manipulation in Bordeaux, are given to the consumer as genuine Medocs. If this be possible in the dry and heated climate of Algeria, there can be little doubt of the efficacy of the same treatment under the more favorable conditions which obtain in California.

CABERNET SAUVIGNON.

(See Vit. Rept. 1883-85, p. 86; 1886, p. 70; 1887-89, p. 43.)

This variety, the most famed of all red-wine grapes, has now been extensively tried in California, successfully in some places, with poor results in others. In cool localities, where the soil is fairly rich, it is a vigorous grower, shades its grapes well, and bears fair crops. In warmer localities, and on light or dry soil, it is apt to lack enough foliage to properly shade the grapes. This can generally be remedied by close planting and judicious summer pruning. It is a good variety for localities subject to early spring frosts, on account of the late starting of the buds. The berries are solid, well attached to the stalk, and resist rain very well.

The must reaches a good percentage of sugar with sufficient acid.

The average for the coast counties is about 23% to 25% of sugar, with 0.60% to 0.40% of acid. It ferments well, and the wine is one of the best keepers tested. One of the most invaluable qualities of this grape is the exceptional cleanness of the bunches; that is, the absence of rotten, moldy, or broken grapes. This quality has led to its successful use in the making of "levains" or yeasts with which to start other grapes and insure a prompt and pure fermentation.

The greatest faults of the wine of the Cabernet Sauvignon are its excessive astringency and sometimes excessive color. These may be called good faults, for they are easily remedied by blending, and are among the principal causes which make this wine such an excellent keeper. Wines made from this grape in the localities where it attains its highest qualities are so rough, even at the end of three or four years, that they are not agreeable to use alone. One of the best blends for California seems to be one-half Cabernet Sauvignon and one half Beclan. The addition of Beclan moderates the tannin, acid, and color of the Cabernet without destroying or disguising its individuality. The usual French blends with Verdot, Merlot, or Malbeck are not suitable for our conditions, as these varieties all possess in a greater or less degree the faults of the Cabernets. At Tulare, the behavior of the Cabernet Sauvignon has been somewhat of a surprise; where the alkali is not too strong, it grows thriftily, makes plenty of foliage, and bears about two to three tons per acre. In strong alkali it is subject to coulure and sunburn. The berries are small, and with little or none of the Cabernet flavor; they are, however, juicy, with fair acid, and make a wine of good color and fair quality, inferior, however, to that of Mondeuse from the same vineyard.

ANALYSES OF MUSTS AND WINES.

CABERNET SAUVIGNON.	Date of Picking.	MUST.				WINE.						
		Solid Contents by Spindle.	Sugar by Copper Test.	Acid as Tartaric.	Ash.	Alcohol.		Tannin.	Total Acid as Tartaric.		Body.	Ash.
						By Weight.	By Volume.		At Pressing.	At Six Months.		
1890—No. 1248. Margherita Vineyard, Fresno	Aug. 25	22.40	21.80	.65	.32	.....	.....	.....	.....	.....	.....	.....
No. 1342. Mission San José	Oct. 11	22.90	.....	.62	.26	9.12	11.36	.252	.....	.40	2.78	.....
No. 1347. Cupertino	Oct. 12	24.80	.....	.40	.....	.....	.....	.....	.....	.....	.....	.....
1891—No. 1554. Paso Robles	Oct. 6	25.65	.....	.41	.....	.....	.....	.....	.....	.....	.....	.....
No. 1591. Mission San José	Oct. 14	25.40	24.11	.44	.....	.....	.....	.....	.....	.....	.....	.....
1892—No. 1662. Amador station	Sept. 16	22.95	.....	.57	.....	.....	.....	.....	.....	.....	.....	.....
No. 1750. Paso Robles	Oct. 11	24.80	.....	.31	.....	.....	.....	.....	.....	.....	.....	.....
No. 1765. Mission San José	Oct. 12	21.95	21.22	.77	.....	8.70	10.83	.199	.69	.63	2.85	.....
1893—No. 1820. Amador station	Sept. 6	22.70	.....	.80	.21	.....	.....	.....	.....	.....	.....	.....
No. 1892. Tulare	Sept. 21	23.70	20.99	.37	.....	.....	.....	.....	.....	.....	.....	.....
No. 1914. Paso Robles	Oct. 6	24.80	25.19	.53	.23	9.34	11.64	.....	.....	.46	3.10	.23
No. 1950. Mission San José	Oct. 14	22.10	.....	.58	.....	.....	.....	.....	.....	.....	.....	.....
1894—No. 2207. Tulare	Sept. 25	25.50	24.12	.39	.....	.....	.....	.....	.....	.....	.....	.....
No. 2282. Amador station	Oct. 4	25.45	23.61	.53	.....	.....	.....	.....	.....	.....	.....	.....
No. 2303. Mission San José	Oct. 11	29.00	.....	.47	.....	.....	.....	.....	.....	.....	.....	.....

COLOR READINGS.

CABERNET SAUVIGNON.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1892—No. 1765. Mission San José	125.0	1VR	74.2	1VR	72.8	1VR	72.8	1VR	56.3	1VR	43.0	2VR
1893—No. 1914. Paso Robles	55.5	1VR	27.0	3VR	23.5	3VR	25.0	5VR	11.1	1R	9.3	2R

RECORD OF TREATMENT.

No. 1248. *Cabernet Sauvignon*, from Margherita Vineyard, Fresno. A small sample arrived August 26, 1890, in good condition, well ripened, but both bunches and berries very small. The must showed 22.4% of solid contents. This sample was fermented with No. 1250, Merlot.

No. 1342. *Cabernet Sauvignon*, from Mission San José. Received October 14, 1890, in good condition, and mature. The must showed 22.9% of solid contents by spindle. The temperature of the must at crushing was 68°, and on the fourth day the cap had risen to 86°, and the violent fermentation was over; the next day the wine was dry.

In three weeks from crushing the wine was clear. At four months the wine was racked for the second time, and was bright, much improved, with good flavor, tannin, and acid, but a slightly suspicious taste. A month later the lees showed a few lactic ferments, and the wine was pasteurized. At seven months it was bright and generally good but for its odor. At fourteen months the wine had been racked four times, and was bright, possessed of a full and characteristic flavor, but was somewhat thin and exhausted and had a slight butyric odor. Two months later it was bottled. At two years the bottled wine showed high qualities of flavor, tannin, and acid, but was spoiled by butyric odor.

No. 1347. *Cabernet Sauvignon*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in fair condition, a few of the grapes moldy and some dried up. The must showed 24.8% of solid contents by spindle.

No. 1554. *Cabernet Sauvignon*, from Paso Robles. A sample for must analysis arrived October 8, 1891, in good condition. The bunches and berries were of medium size for the variety, and the grapes mature. The must showed 25.65% of solid contents by spindle.

No. 1591. *Cabernet Sauvignon*, from Mission San José. A sample for must analysis arrived October 16, 1891, in fair condition. The must showed 25.4% of solid contents by spindle.

No. 1662. *Cabernet Sauvignon*, from Amador station. A sample for must analysis arrived September 19, 1892, in good condition. The must showed 22.95% of solid contents by spindle.

No. 1750. *Cabernet Sauvignon*, from Paso Robles station. A sample for must analysis arrived in good condition. The must showed 24.8% of solid contents by spindle.

No. 1765. *Cabernet Sauvignon*, from Mission San José. Received October 15, 1892, in good condition. The must showed 21.95% of solid contents by spindle. The temperature of the must at crushing was 58°, and the maximum temperature reached was 84°, on the fourth day. On the fifth day the wine was nearly dry, and was pressed.

The wine was somewhat slow in clearing, but at three months was bright and showed rich aroma and flavor, with medium acid and astringency. It improved gradually, preserving its pronounced flavor, and finally losing the slight moldy smell which it had at first. At fourteen months it was very good, but not mature. At twenty-one months it was bottled.

No. 1820. *Cabernet Sauvignon*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition. The bunches were loosely but fairly well filled with small berries. The grapes had some of the Cabernet flavor. The must showed 22.7% of solid contents by spindle.

No. 1892. *Cabernet Sauvignon*, from Tulare station. A sample for must analysis arrived September 23, 1893, in good condition. The bunches were small and coulured; the berries small, sunburned, and flavorless, but very sweet. The must showed 23.7% of solid contents by spindle.

No. 1914. *Cabernet Sauvignon*, from Paso Robles station. Received October 6, 1893, in fair condition. The bunches and berries were both of good size, the former somewhat affected by coulure. The grapes were well flavored. The must showed 24.8% of solid contents by spindle. The temperature at crushing was 63°, and the maximum reached was 83°, on the fourth day. The fermentation was a little slow toward the end, and the murk was pressed out while still a little sweet. It was left in the fermenting-room for two days after pressing, and at the end of that time was dry.

The wine was nearly clear at the end of six weeks, but was extremely rough. At three months it was bright, possessed of high flavor and aroma, full but agreeable astringency, medium acid, and high body. At seven months it was in excellent condition, and generally a fine wine, but the Cabernet character was not very pronounced.

No. 1950. *Cabernet Sauvignon*, from Mission San José. A sample for must analysis was received October 14, 1893, in bad condition. The bunches were small, well filled with berries of good size. The grapes were highly flavored and mature, but had become moldy by being too long on the road, so were not made into wine. The must showed 22.1% of solid contents by spindle.

CABERNET FRANC.

(See Vit. Rept. 1883-85, p. 84; 1886, p. 68; 1887-89, p. 38.)

The success of this variety has been much more limited than that of its congener, Cabernet Sauvignon. This is partly owing to the fact that unless the cuttings used in planting are carefully selected from well-bearing vines, they are apt to give unproductive or absolutely sterile vines. It is also more deficient in foliage than Cabernet Sauvignon, and in dry soils is liable to be badly sunburned. Close training on wires, and careful summer pruning, may be relied on to counteract this tendency.

Further analyses of this variety show that it maintains its character of full sugar contents, with medium to low acid. A sample of wine made from grapes grown at the Paso Robles station shows the usual high body and medium astringency of this variety; its color was at first good, but lacked stability.

ANALYSES OF MUSTS AND WINES.

CABERNET FRANC.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At Six Months	
1891—No. 1522. Mission San José	Sept. 29	26.95	26.31	.44							
No. 1559. Paso Robles	Oct. 6	23.50		.58							
1892—No. 1762. Paso Robles	Oct. 11	22.85		.50							
1893—No. 2070. Paso Robles	Nov. 3	26.70	25.76	.43	.30	9.92	12.36	.262	.49	.36	3.15
1894—No. 2294. Mission San José	Oct. 10	23.20		.36							

COLOR READINGS.

CABERNET FRANC.	At Pressing		One Month.		Two Months.		Three Months.		Four Months.	
1893—No. 2070. Paso Robles	59.7	VR	38.4	2VR	33.6	5VR	32.8	4VR	8.3	(Y)

Record of Treatment.

No. 1522. *Cabernet Franc*, from Mission San José. A sample for must analysis arrived October 1, 1891. The must showed 26.95% of solid contents by spindle.

No. 1559. *Cabernet Franc*, from Paso Robles. A sample for must analysis arrived October 8, 1891, in good condition. The grapes were large for the variety, and mature. The must showed 23.5% of solid contents by spindle.

No. 1762. *Cabernet Franc*, from Paso Robles. Received October 14, 1892, in good condition. The must showed 22.85% of solid contents by spindle. The grapes were fermented with No. 1761, Tannat, from Paso Robles.

No. 2070. *Cabernet Franc*, from Paso Robles. Received November 3, 1893, in fair condition. The bunches were of medium size, very much branched, irregular, loose, coulured; the berries small, well flavored, but overripe. The must showed 26.7% of solid contents by spindle. The temperature of the must at crushing was 66°, and the maximum of 80° was reached on the third day. The wine was dry on the fifth day, when it was pressed.

The wine was clear at the end of a month, but tasted bitter. At the end of two months it had been racked twice, was clear, very heavy-bodied, with a fairly good flavor, but flat.

MERLOT.

(See Vit. Rept. 1887-89, p. 54.)

This variety has been as distinct a failure in California as the Malbeck, and for the same reason—viz., failure to bear, added to which is its liability to loss of its leaves from sunburn. This is somewhat strange, as in Europe it has the reputation of being a heavy bearer. There, however, it is only planted on cool, northern slopes, for in other positions it ripens too quickly and is easily injured by the sun. The grapes have a very agreeable and distinctive flavor, similar to that of the Cabernet Sauvignon, not, however, perceptible in the wine, which is of a neutral character.

The composition of such grapes as have been analyzed at the station show the effect of growing on too warm an exposure. The sugar contents have been higher on the average, and the acid lower, than in the case of any other of the Bordeaux grapes. The Merlot is particularly unsuited to the Paso Robles district, as, judging from the observations made at that station, and from the analyses of musts received from there, its defects are emphasized and it loses much of its flavor and color.

Analyses of Musts and Wines.

MERLOT.		Date of Picking.	MUST.			WINE.		
			Solid Contents by Spindle.	Sugar by Copper Test.	Acid as Tartaric.	Ash.	Tannin.	Total Acid as Tartaric at Pressing.
1890—No. 1218.	Fresno	Aug. 22	23.70	......	.28	......	......	......
No. 1366.	Cupertino	Oct. 14	26.30	......	.38	......	......	......
No. 1380.	Mission San José	Oct. 19	28.80	......	.40	......	......	......
1891—No. 1586.	Mission San José	Oct. 14	25.90	24.96	.36	.44	......	......
1893—No. 1955.	Paso Robles	Oct. 15	28.40	28.33	.29	.33	.326	.41
No. 1993.	Mission San José	Oct. 19	25.90	......	.58	......	.451	.68
No. 2060.	Cupertino	Oct. 31	26.30	......	.51	......	.294	.74
1894—No. 2259.	Mission San José	Oct. 3	23.70	......	.49	......	......	......

COLOR READINGS.

MERLOT.	At Pressing.	
1893—No. 1955. Paso Robles	27.4	5VR
No. 1993. Mission San José	121.0	VR
No. 2060. Cupertino	48.2	3VR

RECORD OF TREATMENT.

No. 1218. *Merlot*, from Margherita Vineyard, Fresno. A sample for must analysis arrived August 25, 1890, in good condition, overripe, and some of the grapes dried. The must showed 23.7% of solid contents by spindle.

No. 1366. *Merlot*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 17, 1890, in good condition, a little overripe, the berries a little shriveled, but not dried up. The must showed 26.3% of solid contents by spindle.

No. 1380. *Merlot*, from Mission San José. A sample for must analysis arrived October 20, 1890, in fair condition, mature, and a few of the grapes dried. The must showed 28.8% of solid contents by spindle.

No. 1586. *Merlot*, from Mission San José. A sample for must analysis arrived October 16, 1891, in fair condition. The bunches were loose and straggling, the berries small. The must showed 25.9% of solid contents by spindle.

No. 1955. *Merlot*, from Paso Robles. A sample for must analysis and for color and tannin tests arrived October 15, 1893, in fair condition. The bunches were large, irregular, loose, and winged; the berries small, round, on long, slender pedicels. The grapes were of good flavor, and mature. The must showed 28.4% of solid contents by spindle.

No. 1993. *Merlot*, from Mission San José. A sample for must analysis and for color and tannin tests was received October 19, 1893, in good condition. The bunches were of medium size, irregular, loose, and branching; the berries small; the peduncles and pedicels very slender. The grapes were mature and highly flavored. The must showed 25.9% of solid contents by spindle.

No. 2060. *Merlot*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were small, spreading, well filled, but not close; the berries small, round, firm, of characteristic flavor, quite mature. The must showed 26.3% of solid contents by spindle.

MALBECK OR CÔT.

(See Vit. Rept. 1883–85, p. 83; 1886, p. 87; 1887–89, p. 32.)

The latest tests of the Malbeck have developed no new points in its favor, but have, on the contrary, proved pretty conclusively its unfitness for Tulare and similar localities. It has not borne well at any of the stations; at Paso Robles, where it has done best, it gave less than two tons to the acre. On the whole, it seems better adapted to the conditions at Paso Robles than at any other locality tried so far; it gives a wine of good body, acid, and astringency. It commenced with an amount of color equal to that attained at Cupertino, but dropped it very badly. It has in this locality shown the excellent quality of retaining a good amount of acid, even when somewhat overripe and very high in sugar. In general, the composition of the must is satisfactory wherever the variety has been grown; but so far no locality has been tested where it overcomes its radical defect of unfruitfulness (in consequence of coulure or failure to set), which at Mission San José has continued to characterize it to such extent as to amount to absolute failure.

ANALYSES OF MUSTS AND WINES.

MALBECK.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
1890—No. 1303.	Mission San José	Oct. 5	24.55		.56	.38						
No. 1321.	Cupertino	Oct. 11	25.20		.53							
1891—No. 1475.	Fresno	Aug. 29	25.00	24.64	.55	.51						
No. 1489.	Paso Robles	Sept. 9	28.80	29.07	.54							
1892—No. 1653.	Paso Robles	Sept. 13	22.15	21.80	.53	.34						
No. 1665.	Amador station	Sept. 16	24.25		.58							
No. 1679.	Tulare	Sept. 17	22.80		.44							
1893—No. 1797.	Tulare	Aug. 31	21.10	18.90	.62	.45	7.43	9.27	.298	.51	.67	3.80
No. 1817.	Amador station	Sept. 8	21.50	20.99	.78	.26			.294	.72		
No. 1917.	Paso Robles	Oct. 7	26.30	24.64	.50	.38	9.85	12.20	.272	.48	.44	3.30
No. 2055.	J. T. Doyle, Cupertino	Oct. 31	25.20		.62				.384	.90		
1894—No. 2208.	Tulare	Sept. 20	22.60		.53							
No. 2274.	Mission San José	Oct. 3	22.60		.50							

COLOR READINGS.

MALBECK.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1893—No. 1797.	Tulare	33.3 1VR	32.5 5VR	19.1 R	17.6 2R	17.4 2R	
No. 1817.	Amador station	70.2 1VR					
No. 1917.	Paso Robles	90.9 VR	35.4 1VR	27.9 1VR	28.8 2VR	9.3 (Y)	8.7 (Y)
No. 2055.	Cupertino	90.9 VR-1VR					

RECORD OF TREATMENT.

No. 1303. *Malbeck*, from Mission San José. A sample for must analysis arrived October 7, 1890, in bad condition. The must showed 24.55% of solid contents by spindle. The grapes were fermented with No. 1302, Tannat, from Mission San José.

No. 1321. *Malbeck*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in bad condition. The must showed 25.2% of solid contents by spindle.

No. 1475. *Malbeck*, from Margherita Vineyard, Fresno. A sample for must analysis and color test arrived August 31, 1891, in fair condition. The must showed 25.0% of solid contents by spindle.

No. 1489. *Malbeck*, from Paso Robles station. A sample for must analysis arrived September 11, 1891, in good condition. The must showed 28.8% of solid contents by spindle.

No. 1653. *Malbeck*, from Paso Robles station. A sample for must analysis and color test arrived September 16, 1892, in good condition. The must showed 22.15% of solid contents by spindle.

No. 1665. *Malbeck*, from Amador station. A sample for must analysis arrived September 19, 1892, in poor condition. The must showed 24.25% of solid contents by spindle.

No. 1679. *Malbeck*, from Tulare station. A sample for must analysis arrived September 21, 1892, in good condition. The must showed 22.8% of solid contents by spindle.

No. 1797. *Malbeck*, from Tulare station. Received August 31, 1893, in good condition. The bunches were well filled, the berries of good size and well colored, but tasteless. The must showed 21.1% of solid contents by spindle. The must at crushing had a temperature of 63°, and was very slow in starting. On the fifth day the fermentation was so slow that it was hastened by placing the vat in an outside temperature of 90°. This had the desired effect, and in three days more the wine was dry. The maximum temperature reached was 96°, on the seventh day.

The wine became clear in a month, but soon commenced to deteriorate. At three months it was very flat and inferior, and at seven months quite spoiled.

No. 1817. *Malbeck*, from Amador station. A sample for must analysis and for color and tannin tests was received September 8, 1893, in good condition. The bunches were close, medium sized; the berries of medium size and good flavor. The must showed 21.5% of solid contents by spindle.

No. 1917. *Malbeck*, from Paso Robles station. Received October 7, 1893, in somewhat crushed condition, but not moldy. The bunches were small, but well filled; the berries of medium size, very ripe, and of good flavor. The must showed 26.3% of solid contents by spindle. The initial temperature of the must was 68°, and the maximum temperature reached, on the third day, 84°. The fermentation was finished on the sixth day.

Three weeks from pressing, the wine was nearly clear and was very astringent. At three months it was clear, of good color and flavor, full-bodied, and with plenty of astringency, but not quite clean-tasting. At seven months it had improved and developed some bouquet, but the after-taste was not good and was slightly bitter.

No. 2055. *Malbeck*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The bunches were small and coulured; the berries of medium size, crisp, juicy, well flavored, and quite mature. The must showed 25.2% of solid contents by spindle.

VERDOT.

(See Vit. Rept. 1883-85, p. 88; 1885, p. 71; 1887-88, p. 60.)

The Gros and the Petit Verdot seem to be simply variations of the same variety produced by selection; the former is a better bearer and produces larger berries. But there is little or no difference in the character of the wine. This variety has succeeded much better than either the Malbeck or the Merlot, bearing fair crops and, though possessing a less dense foliage, generally shading its grapes sufficiently. It is vigorous, but requires long-pruning and a fairly rich soil. The young canes are brittle and liable to damage from the wind in the spring. The average crop in suitable soil is about three to four tons per acre, but less when the soil is too light or too dry. The average crop at Cupertino has been about two tons per acre. At Tulare the crop has been about the same, but the vine does not do well in alkali soil.

The Verdot ripens later than the Cabernets, and while attaining an almost equal amount of sugar, retains a much higher acidity. The average composition of the must in ordinary years is—at Cupertino, 24.5% of sugar and 0.86% of acid; at Mission San José, 24.5% of sugar and 0.84% of acid; at Tulare, 24% of sugar and 0.53% of acid; at Paso Robles, 24.2% of sugar and 0.47% of acid. This shows good acidity, even at the southerly stations. The must is thus easily fermented, and produces a wine of excellent keeping qualities. The wine is very astringent, but less rough at first than Cabernet Sauvignon, to which, however, it is much inferior in distinctive flavor. Its most profitable use is as a blend with high-class wines needing an addition of acid and tannin.

ANALYSES OF MUSTS AND WINES.

VERDOT.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At 6 to 8 Months	
1890—No. 1223. Fresno	Aug. 22	23.70	23.62	.57	.33						
No. 1250. Fresno	Aug. 25	24.10	23.62	.57	.27	9.70	12.09	.278	.41	.57	3.08
No. 1331. Cupertino	Oct. 1	21.05		.92							
No. 1382. Mission San José	Oct. 18	25.00		.99	.23	9.92	12.36	.320		.39	3.32
1891—No. 1551. Paso Robles	Oct. 6	23.40		.39							
No. 1592. Mission San José	Oct. 13	24.00	24.11	.82	.40	10.44	11.91	.291	.67	.49	3.20
1892—No. 1681. Tulare	Sept. 19	23.70		.39							
No. 1726. Paso Robles	Oct. 10	25.90		.48							
No. 1736. Paso Robles	Oct. 10	20.60		.53							
1893—No. 1828. Amador station	Sept. 8	21.50		1.23				.386	1.13		
No. 1935. Paso Robles	Oct. 13	26.95	26.24	.49	.31			.534	.41		
No. 1942. Tulare	Oct. 13	22.35	21.38	.63	.23			.438	.56		
No 1991. Mission San José	Oct. 19	24.10		.92				.425	.85		
No. 2043. Cupertino	Oct. 31	25.70		1.10				.355	.94		
No. 2115. Cupertino	Nov. 6	26.30		1.15				.400	.79		
No. 2124. Cupertino	Nov. 6	25.70		1.01							
1894—No. 2306. Mission San José	Oct. 10	25.00		.64							
No. 2317. Tulare	Oct. 13	26.00		.47							

COLOR READINGS.

VERDOT.	At Pressing.	One Month.	Two Months.	Three Months.	Four Months.
1891—No. 1592. Mission San José	120 VR	88.8 2VR	58.0 2VR	58.0 2VR	41.2 2VR
1893—No. 1828. Amador	174 VR	111.0 1VR	....	....	....
No. 1935. Paso Robles	100 VR	....	....	....	....
No. 1942. Tulare	69 VR	....	....	....	....
No. 1991. Mission San José	133 VR	....	....	....	....
No. 2043. Cupertino	114 1VR	....	....	....	....
No. 2115. Cupertino	87 1VR	....	....	....	....

RECORD OF TREATMENT.

No. 1223. *Petit Verdot*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 25, 1890, in good condition, but a little overripe. The must showed 23.7% of solid contents by spindle.

No. 1250. *Petit Verdot*, from Margherita Vineyard, Fresno. Received August 27, 1890, in good condition. The bunches were small; the berries small, thin-skinned, and juicy. The must showed 24.1% of solid contents by spindle. The temperature of the must at crushing was 69°, and the highest temperature reached during fermentation was 92°, on the fourth day. The murk was drawn off and the pomace pressed on the sixth day, though a little sugar still remained. This sample was fermented with No. 1248, Cabernet Sauvignon, from the same vineyard. The proportion of each variety was Verdot 78%, Cabernet 22%.

Blend of Verdot and Cabernet Sauvignon. The wine fermented slowly for some time, but was quite dry at the end of a month. At two months it was clear, of fair color, medium astringency and acid, but flat and of suspicious taste. At three months the lees showed lactic filaments and the taste was affected; aside from this the wine was of rather good quality. A few days after this it was pasteurized. After pasteurizing, the wine was racked twice, and gradually improved, losing its lactic taste and becoming bright. The wine was bottled, part at eighteen months and part at twenty-four months. At twenty-eight months both wines were tasted and found bright and with fairly good color. That first bottled had the most flavor, but the other was the cleaner-tasting, though neither wine was quite fresh or clean-tasting.

No. 1331. *Gros Verdot*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 3, 1890, in good condition, and mature. The must showed 21.05% of solid contents by spindle.

No. 1382. *Petit Verdot*, from Mission San José. Received October 20, 1890, in very good condition; the bunches and berries were extremely small. The must showed 25.0% of solid contents by spindle. The temperature of the must at starting was 68°, and the maximum, reached on the third day, was 93°. The murk was dry on the fourth day, and was drawn off.

At one month the wine was clear, of good flavor, high astringency, medium acid, and full body. At three months the wine was racked for the second time and, the lees showing some lactic filaments, it was pasteurized. It was bright, of good bouquet and flavor, and the lactic tint was not perceptible to taste. At seven months it had improved, and was full flavored and very good, but still very rough. At fourteen months it had improved, and kept well in spite of the small size of the sample (three gallons), and was quite mature. At sixteen months it was bottled. At one year after bottling the wine was bright and of high quality and remarkably clean-tasting, considering the small size of the sample made.

No. 1551. *Gros Verdot*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition. The bunches were small; the berries of medium size and mature. The must showed 23.4% of solid contents by spindle.

No. 1592. *Petit Verdot*, from Mission San José. Received October 16, 1891, in fair condition. The must showed 24.0% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the highest reached was 80°, on the third day. The murk was dry on the fourth day, and was drawn off.

But two gallons of wine were made, and consequently it soon became flat. It showed, however, remarkable keeping qualities, and successive tastings at one, two, four, seven, and nine months show a gradual improvement of flavor. It was put in glass at nine months.

No. 1681. *Gros Verdot*, from Tulare station. A sample for must analysis was received September 21, 1892, in good condition. The must showed 23.7% of solid contents by spindle.

No. 1726. *Petit Verdot*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The grapes were very small. The must showed 25.9% of solid contents by spindle.

No. 1736. *Gros Verdot*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 20.6% of solid contents by spindle.

No. 1828. *Gros Verdot*, from Amador station. See No. 1828, Petit Verdot.

No. 1828. *Petit Verdot and Gros Verdot*, from Amador station. A sample for must analysis and for tannin and color tests was received September 8, 1893, in good condition. The Petit Verdot was very small and coulured, the Gros Verdot had small bunches well filled with larger berries; the grapes were well colored. The must showed 21.5% of solid contents by spindle.

No. 1935. *Petit Verdot*, from Paso Robles station. A sample for must analysis and for color and tannin tests was received October 13, 1893, in good condition. The bunches were small and loose; the berries very small, mature, and well flavored. The must showed 26.95% of solid contents by spindle.

No. 1942. *Petit Verdot*, from Tulare station. A sample for must analysis and for color and tannin tests was received October 13, 1893, in good condition. The bunches were small, close, regularly short cylindrical; the berries of medium size, fresh-tasting, mature, with good acid. The must showed 22.35% of solid contents by spindle.

No. 1991. *Petit Verdot*, from Mission San José. A sample for must analysis and for color and tannin tests was received October 19, 1893, in good condition. The bunches were small to medium, well filled, but not compact; the berries small, equal, quite mature. The must showed 24.1% of solid contents by spindle.

No. 2043. *Gros Verdot*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were small, cylindrical, often in two branches, loose, coulured; the berries of medium size, commencing to dry up, but still with good acid. The must showed 25.7% of solid contents by spindle.

No. 2115. *Petit Verdot*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received November 6, 1893, in good condition. The bunches were under medium size, close, conical to cylindrical, with small shoulders; the berries under medium size, firm, juicy, sweet, but with very few dried berries. The must showed 26.3% of solid contents by spindle.

No. 2124. *Gros Verdot*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were over medium size, much winged, loose, on slender red peduncles; the berries of medium size, round, crisp, commencing to shrivel, but with good acid. The must showed 25.7% of solid contents by spindle.

GAMAI TEINTURIER.

(See Vit. Rept. 1885, p. 86; 1887-89, p. 71.)

This is a grape deserving of more extended attention than it has yet received. It is not a very vigorous grower, but is fairly resistant to coulure, rain, etc., and with long-pruning gives fair crops (two to four tons per acre, at Cupertino). At Tulare station it is planted in alkali too strong for any variety, but the composition of the must is very satisfactory. The grapes are of medium size, not too compact, and ripen about two weeks before the Cabernet Sauvignon. The average composition of the must in ordinary years is: at Cupertino, 23.9% of sugar and 0.82% of acid; at Mission San José, 24.7% of sugar and 0.77% of acid; at Tulare, 26.2% of sugar and 0.64% of acid; at the Amador station, 23.1% of sugar and 0.73% of acid; at Paso Robles, 23.0% of sugar and 0.68% of acid. Thus, at all stations, with a full or somewhat high percentage of sugar, it maintains uniformly a good percentage of acid. The composition of the must insures a quick and thorough fermentation; the wine is without special flavor, but full-bodied, fresh-tasting, and quick to mature.

As a color wine, it is much superior in California to the Teinturiers, in having an almost equal amount of color and superior keeping qualities. The color is particularly stable, both in tint and intensity. Though essentially in character a grape of the Bordeaux type, it would make an excellent blend for correcting the faults of our Pinots in some districts, where they are subject to the mannitic or other injurious after-fermentations. It would give them the color, acid, and keeping qualities they need, without disguising or spoiling their own peculiar flavor and bouquet.

Its tannin content, as a rule, is adequate, but not high, so that the wine is never so intensely rough as the Carbernets often are.

ANALYSES OF MUSTS AND WINES.

GAMAI TEINTURIER.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1228.	Fresno	Aug. 23	25.40	25.76	.64	.40						
No. 1276.	Cupertino	Oct. 1	21.93		.80	.23	9.25	11.45	.202	.84	.52	2.58
1891—No. 1580.	Mission San José	Oct. 13	26.80	26.99	.65		11.23	13.73	.307	.75	.50	2.70
1892—No. 1684.	Mission San José	Sept. 24	24.10		.93		9.49	11.82	.232	.84	.86	3.10
No. 1663.	Amador station	Aug. 30	25.86		.58							
1893—No. 1823.	Amador station	Sept. 8	20.20		.88				.253	1.00		
No. 1866.	Paso Robles	Sept. 15	23.05	20.99	.68	.24	8.48	10.58	.122	.56	.55	2.95
No. 1893.	Tulare	Sept. 25	26.90	24.12	.64	.40			.317	.71		
No. 1945.	Mission San José	Oct. 14	23.20		.87				.428	.86		
No. 2128.	Cupertino	Nov. 6	26.50		.68				.349	.71		
1894—No. 2265.	Mission San José	Oct. 3	25.65		.80							

COLOR READINGS.

GAMAI TEINTURIER.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1580.	Mission San José	149.0	1VR	102.6	2VR	100.0	2VR	46.5	2VR	52.0	4VR		
1892—No. 1684.	Mission San José	142.0	1VR	118.0	2VR	103.0	2VR	90.9	1-2VR	81.6	2VR	69.0	2VR
1893—No. 1823.	Amador station	64.5	1VR										
No. 1866.	Paso Robles	22.3	R	17.4	4VR	13.4	5VR	10.5	5VR	11.9	5VR	11.1	5VR
No. 1893.	Tulare	22.6	1R										
No. 1945.	Mission San José	154.0	1VR										
No. 2128.	Cupertino	100.0	1VR										

RECORD OF TREATMENT.

No. 1228. *Gamai Teinturier*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 25, 1890, in good condition, but some of the grapes had commenced to dry up. The must showed 25.4% of solid contents by spindle.

No. 1276. *Gamai Teinturier*, from J. T. Doyle, Cupertino. Received October 2, 1890, in fair condition. Grapes small and not quite mature; a few bunches moldy. The must showed 21.93% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the highest temperature reached was 89°, on the fourth day. The murk was dry on the sixth day, and was drawn off.

The wine fermented slowly for some time and was a little slow in clearing, but in two months it was clear, with good acid and astringency, but with a slight odor of mold. At four months the lees showed a little lactic taint, so the wine was pasteurized. The lactic taint was not perceptible to taste, and the wine was clear. Four months after pasteurizing it was bright, with little bouquet but agreeable flavor, and generally improved. At ten months it was racked for the third time; at fifteen months it was bright, had rich ruby color, little bouquet, full rich flavor, with no trace of moldiness; mature, and of good quality. It was bottled—part at seventeen and part at twenty-three months. At twenty-seven months both samples were tasted. That bottled at seventeen months was flat, cloudy, and of poor quality; that bottled at twenty-three months was in excellent order, very smooth, agreeable, and clean-tasting.

No. 1580. *Gamai Teinturier*, from Mission San José. Received October 16, 1891, in fair condition. The must showed 26.8% of solid contents by spindle. The temperature of the must at starting was 68°, and the maximum temperature arrived at was 86°, on the third day. On the fourth day the murk was drawn off nearly dry.

At one month the wine was clear, smooth, and full-bodied, but a little flat. At two months the lees showed lactic germs, so the wine was pasteurized. A month later the wine was sound, but lacked freshness. At seven months it was much improved, had developed some bouquet, and tasted cleaner and fresher. It continued to improve and develop character till it was fifteen months old, when it was bottled. At three years and a half the wine in bottle was bright, deep-colored, with good flavor and some bouquet; it was a solid wine with good astringency and body, and medium acid.

No. 1684. *Gamai Teinturier*, from Mission San José. Received September 27, 1892, in good condition. The must showed 24.1% of solid contents by spindle. The temperature of the must at starting was 68°, and the highest temperature reached was 94°, on the third day. The murk was dry on the fifth day, and was drawn off.

The wine was clear within a month from crushing. At three months it was bright, the bouquet good, acid very sharp, flavor not marked. It improved with age, and at five months, when it was racked for the second time, it was smoother, but the acid was still harsh. It remained bright and sound, and at eighteen months was put in bottle.

No. 1663. *Gamai Teinturier*, from Amador station. Received September 1, 1892, in poor condition. The must showed 25.86% of solid contents by spindle.

No. 1823. *Gamai Teinturier*, from Amador station. A sample for must analysis and for color and tannin tests was received September 8, 1893, in good condition. The bunches were small and well filled, with good-sized berries, well colored and ripe. The must showed 20.2% of solid contents by spindle.

No. 1866. *Gamai Teinturier*, from Paso Robles station. Received in good condition September 15, 1893. The bunches were well filled and of good size; the berries somewhat shriveled; the juice only slightly pink. The must showed 23.05% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the highest temperature reached was 89°, on the fourth day. The murk was drawn off dry on the fifth day. In one month the wine was clear, but tasted a little moldy. At four months it was bright, very light in color for the variety, full acid and good flavor. At eight months it had been racked twice, and was much improved, had developed some bouquet, and possessed some flavor; the after-taste was not perfectly clean.

No. 1893. *Gamai Teinturier*, from Tulare station. The grapes arrived on September 25, 1893, in good condition; they were very sweet and past maturity; the bunches and berries were small; the juice slightly pink. The must showed 28.9% of solid contents by spindle. Only a sample for analysis and for color and tannin tests was received.

No. 1945. *Gamai Teinturier*, from Mission San José. A sample for must analysis and for tannin and color tests was received October 14, 1893, in bad condition, having been too long on the road. The grapes were overripe and beginning to dry up. The must showed 23.2% of solid contents by spindle.

No. 2128. *Gamai Teinturier*, from J. T. Doyle, Cupertino. A sample for must analysis and for tannin and color tests was received November 6, 1893, in good condition. The bunches were conical, close, under medium size; the berries of medium size, soft and shriveled, much overripe. The must showed 28.5% of solid contents by spindle.

TEINTURIER.

(See Vit. Rept. 1885, p. 86; 1887, p. 77.)

There are two varieties of the Teinturier, known, according to Mas and Pulliat, as Teinturier mâle (or Dix fois coloré) and Teinturier femelle (or Cinq fois coloré). They deserve mention as having been somewhat widely distributed in California, luckily only in small quantities. The former is also called in California, but erroneously, Pied de Perdrix. It is the more deeply colored, but lacks vigor and bears sparingly. The other, known generally simply as Teinturier, is slightly more productive. Neither variety can be recommended either for quality or quantity, and are both equaled if not surpassed as coloring grapes by the Petit Bouschet, Gamai Teinturier, and even by several grapes with white juice. The two varieties are easily distinguished by the leaves; those of the Teinturier mâle are red from the beginning, while those of the Teinturier femelle only turn red as they commence to mature. Moreover, the canes of the Teinturier mâle show in the cross-section a red center spot which the other does not. It is rare to find either variety with bunches having sound berries throughout.

ANALYSES OF MUSTS AND WINES.

TEINTURIER.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1205.	Fresno	Aug. 12	24.55	24.43	.48	.54	9.34	11.64	.210	.46	.38	3.20
No. 1235.	Fresno	Aug. 23	22.00	21.80	.71	.43						
No. 1283.	Cupertino	Oct. 1	25.20		.70	.32	9.92	12.36	.359	.54	.32	3.28
No. 1292.	Mission San José	Oct. 1	23.60		.80	.21	9.34	11.64	.310	.71	.37	2.78
1891—No. 1497.	Paso Robles	Sept. 13	21.50	20.99	.57	.33	7.99	10.00	.100	.53	.53	3.05
No. 1521.	Mission San José	Oct. 1	25.90	25.19	.60		10.26	12.13	.311	.74	.59	3.05
No. 1587.	Mission San José	Oct. 14	27.55	26.99	.55							
1892—No. 1666.	Amador station	Sept. 17	26.25		.56							
No. 1710.	Mission San José	Oct. 3	25.00		.70	.32						
1893—No. 1831.	Amador station	Sept. 8	23.70		.60				.361	.75		
No. 1943.	Tulare	Oct. 13	23.45		.74							
No. 1946.	Mission San José	Oct. 14	25.90		.85				.547	.83		
No. 2121.	Cupertino	Nov. 7	26.10		.50				.531			
1894—No. 2151.	Tulare	Sept. 17	24.55		.57							
No. 2196.	Amador station	Sept. 26	28.00		.33							
No. 2271.	Mission San José	Oct. 5	22.70		.53				.305			

COLOR READINGS.

TEINTURIER.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1497.	Paso Robles	15.2	3R+Y	5.5	1VR+Y	6.2	3VR+Y	6.1	3VR+Y	6.3	5VR+Y	4.7	1R+Y
No. 1521.	Mission San José	149.0	2VR	83.3	1VR	58.0	1-2VR	62.5	2VR	54.8	3VR	44.4	3VR
1893—No. 1831.	Amador station	78.4	1VR	61.6	1VR								
No. 1946.	Mission San José	182.0	VR										
No. 2121.	Cupertino	111.0	1VR										
1894—No. 2271.	Mission San José	95.2	VR										

RECORD OF TREATMENT.

No. 1205. *Teinturier mâle*, from Margherita Vineyard, Fresno. Received August 15, 1890, in good condition, perfectly ripe, and a few grapes commencing to shrivel; the bunches were of good size. The must showed 24.55% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum temperature reached was 83°, on the fourth day. The murk was dry on the sixth day, and was drawn off.

The wine was clear in five weeks from pressing. It was at first coarse, but sound and full-bodied, with plenty of tannin and alcohol, and moderate acid. At four months it was bright and generally much improved, agreeably flavored, and with some bouquet. The lees, however, showed a few lactic ferments, so the wine was pasteurized. Successive tastings showed a gradual improvement up to eight months, after which the wine lost in freshness and color. At fifteen months it was bright, very lightly colored for a Teinturier, with good bouquet and flavor, but somewhat exhausted. At seventeen months it was bottled. It was tasted two years after bottling, and found bright, sound, and in good condition, without bad taste, but insipid and neutral.

No. 1235. *Pied de Perdrix*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 25, 1890, in poor condition, and not mature. The must showed 22.0% of solid contents by spindle.

No. 1283. *Teinturier mâle*, from J. T. Doyle, Cupertino. Received October 3, 1890, in fairly good condition. The bunches were often undersized, with many undeveloped berries. The must showed 25.2% of solid contents by spindle. The temperature of the must at crushing was 64°, and the maximum temperature reached was 94°, on the fourth day. The murk was dry on the sixth day, when it was drawn off.

The wine was a little slow in clearing, but at two months it was clear; it was a heavy, very astringent wine of neutral flavor. At three months the lees showed some lactic taint, and the taste had become affected; the wine was pasteurized. After this the wine improved somewhat, became smoother, and retained its high color, but lacked freshness and character. At eighteen months it was bottled, but it did not keep well in glass.

No. 1292. *Teinturier mâle*, from Mission San José. Received October 3, 1890, in good condition. The bunches were well filled and the grapes mature. The must showed 23.6% of solid contents by spindle. The temperature of the grapes at crushing was 63°, and the maximum temperature reached was 87°, on the third day.

The wine was slow in clearing, and commenced to go wrong almost from the beginning; it was heavy-bodied and highly astringent. It was pasteurized at three months, and improved a little after that; it was, however, always a flat and insipid wine, and did not keep well in bottle.

No. 1497. *Teinturier mâle*, from Paso Robles station Received September 16, 1891, in good condition. The must showed 21.5% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum reached was 83°, on the second day. On the third day the murk was nearly dry, and was drawn off.

Three weeks from pressing, the wine was nearly clear and quite dry. At two months it was bright, with very little color, coarse, and earthy. Successive tastings show no improvement; the wine remained clear, but was thin, flat, and without character.

No. 1521. *Teinturier mâle*, from Mission San José. Received October 2, 1891, in good condition. The must showed 25.9% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the highest temperature reached was 84°, on the fourth day. The murk was dry on the fifth day, when it was drawn off.

The wine was a little slow in clearing, and tasted flat. Within a month from pressing the lees showed lactic ferments. The wine was pasteurized at two months. After this the wine became bright and improved somewhat. It soon, however, became decrepit, owing principally, perhaps, to the smallness of the sample.

No. 1587. *Pied de Perdrix*, from Mission San José. A sample for must analysis was received October 16, 1891, in poor condition. The must showed 27.55% of solid contents by spindle.

No. 1666. *Teinturier mâle*, from Amador station. A sample for must analysis arrived September 19, 1892, in poor condition. The must showed 26.25% of solid contents by spindle.

No. 1710. *Teinturier mâle*, from Mission San José. Received October 5, 1892, in fair condition. The must showed 25.0% of solid contents by spindle. This sample was fermented with No. 1709, Bastardo, from Mission San José.

No. 1831. *Teinturier mâle*, from Amador station. A sample for must analysis and for color and tannin tests was received September 8, 1893, in good condition. The bunches were small, but the berries of good size. The must showed 23.7% of solid contents by spindle.

No. 1943. *Teinturier mâle*, from Tulare station. A sample for must analysis was received October 13, 1893, in good condition. The bunches were very small, loose, much coulured; the berries small and overripe, mixed with second crop, to which is doubtless due the somewhat high acid of the must. The must showed 23.45% of solid contents by spindle.

No. 1946. *Teinturier mâle*, from Mission San José. A sample for must analysis and for color and tannin tests was received October 14, 1893, in poor condition. The juice was very deeply colored. The grapes were not as much shriveled as the Gamai Teinturier from the same locality received the same day. The must showed 25.9% of solid contents by spindle.

CHARBONO.

(See Vit. Rept. 1887-89, p. 83.)

This variety was at first planted with some confidence, but later was almost universally discarded. It has, however, some good qualities, which should recommend it for a few localities. It is very vigorous and productive, even on poor soils; bears with short-pruning, and is very free from any disease. The bearing is more regular if the vines are pruned half-long or allowed to extend themselves on trellis or horizontal wires. At Tulare, Amador, and Paso Robles it has been pruned half-long, and has proved one of the most prolific bearers, giving nearly ten tons per acre in the alkali soil of the first mentioned station, and three tons in the light, dry, hill soil of Amador foothill station. At Tulare it produces a good deal of second crop, which colors early and is therefore difficult to separate by unskilled hands. The second crop is, however, almost ripe when the first is ready for picking, and if picked with it, aids the fermentation.

In 1893 the vines bore at the rate of about nine tons per acre, and made a fair wine, which cleared quickly and kept well; it was lacking in smoothness and delicacy, the grapes having been made up with some second crop, and the large crop having prevented the development of its best qualities. In 1894 the crop was only about five tons per acre, and the wine made was proportionally superior. The wine at five months was bright, of good color, full flavor, smooth, and agreeable. The indications are that for bearing, color, and quality, this is one of the best varieties for red wine yet tested in Tulare.

The must has contained from 20% to 24% of sugar at all the stations except those near the bay where the solid contents have seldom exceeded 20%. The acid is somewhat low at the interior stations, but there is generally enough to insure a complete fermentation—at Tulare an average of 0.45%. Except at Paso Robles, the wine has always had good color, not of the brightest tint, but maintaining itself well and not turning yellow. It is generally deficient in tannin, and often in body, and, though generally agreeable at first, becomes flat and insipid in aging. It is not a wine to be kept long or used alone, but its productiveness, good color, and neutral character make it useful as a blend with astringent, light-colored wines. It is likely to be of use, however, only to those with whom quantity is more looked for than quality.

ANALYSES OF MUSTS AND WINES.

CHARBONO.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1891—No. 1536.	Paso Robles	Oct. 6	24.15		.34							
1892—No. 1623.	Tulare	Aug. 30	24.15		.44							
No. 1730.	Paso Robles	Oct. 10	20.00		.51							
1893—No. 1824.	Amador station	Sept. 8	19.30		.74				.320	.80		
No. 1844.	Tulare	Sept. 14	20.85	18.84	.49	.48	7.64	9.54	.141		.49	3.2
No. 1934.	Paso Robles	Oct. 13	23.10	21.63	.48	.34	8.48	10.58	.218	.45	.41	3.1
1894—No. 2212.	Tulare	Sept. 26	24.40		.41							
No. 2283.	Amador station	Oct. 4	24.80	24.12	.44							

COLOR READINGS.

CHARBONO.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1893—No. 1824.	Amador station	80.0 VR-1VR					
No. 1844.	Tulare	50.6 VR	31.7 VR	14.7 5VR	16.5 4VR	12.9 5VR	13.0 4VR
No. 1934.	Paso Robles	48.2 R	26.0 4VR	23.6 2VR	21.1 3VR	7.7 (Y)	7.0 (Y)

RECORD OF TREATMENT.

No. 1536. *Charbono*, from Paso Robles station. A sample for must analysis was received October 8, 1890, in good condition. The bunches were very small, compact, with medium-sized berries. The grapes were mature. The must showed 24.15% of solid contents by spindle.

No. 1623. *Charbono*, from Tulare station. A sample for must analysis was received September 1, 1892, in good condition. The must showed 24.15% of solid contents by spindle.

No. 1730. *Charbono*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 20.0% of solid contents by spindle.

No. 1824. *Charbono*, from Amador station. A sample for must analysis and for color and tannin tests was received September 8, 1893, in good condition. The bunches were well filled with over-average sized berries, well colored, and with some flavor. The must showed 19.3% of solid contents by spindle.

No. 1844. *Charbono*, from Tulare station. Received September 14, 1893, in good condition, except for a few moldy bunches, which were easily picked out. The bunches were large to medium, well filled; the berries of good size, fairly well colored. There were many small, round bunches of second crop, which were nearly ripe, but much more acid than the others. The must showed 20.85% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum reached was 95°, on the third day. The murk was nearly dry on the fourth day, and was drawn off on the fifth.

The wine was clear within a month, and promised well. At four months it was bright, possessed of some bouquet and flavor, full astringency and acid, but lacking in freshness. At seven months it had been racked twice, and was a wine of fair quality, but not quite clean-tasting.

No. 1934. *Charbono*, from Paso Robles station. Received October 13, 1893, in good condition. The bunches were small, cylindrical, close; the berries of medium size. The grapes were quite mature and with little acid. The must showed 23.1% of solid contents by spindle. The temperature of the must was 67° at crushing, and the maximum reached was 81°, on the third day. The murk was dry on the fifth day, when it was drawn off.

The wine was a little slow in clearing, and retained a little sweetness for over three months. At three months it was clear, full-bodied, with good aroma and flavor, low acid, very smooth and slightly sweet, but quite sound. At seven months it was quite dry and in good order. It had been racked twice, and was a good, clean-tasting wine of neutral character.

TANNAT.

(See Vit. Rept. 1883-85, p. 89; 1886, p. 72; 1887-89, p. 48.)

This variety has not been tested very extensively in California, but has many qualities to recommend it. It is a vigorous grower, generally shades its grapes well, and produces rather more freely than the Cabernets. It will bear with short-pruning in some places, but does better with long. The must is characterized by high sugar and acid. Its average composition for five years has been: at Cupertino, 26.2% of sugar and 0.82% of acid; at Mission San José, 26.1% of sugar and 0.62% of acid; at Tulare it lacks acid and the vines do not bear sufficiently; at the Amador station it is one of the best bearers, and has averaged 23.9% of sugar and 0.90% of acid. This is strongly corroborative of the opinion expressed in the Report for 1884, that the Tannat would be a valuable variety for the higher foothills of the upper part of the State. It has also done well at Paso Robles, bearing fairly well and producing a good wine with full acid, medium tannin, and somewhat higher body than is shown by the same variety in the bay counties; it also shows good and fairly stable color, but of a somewhat less pure violet-red tint.

Analyses of Musts and Wines.

TANNAT.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1302.	Mission San José	Oct. 5	27.20		.63	.28	10.81	13.27	.237	.51	.39	3.50
No. 1389.	Cupertino	Oct. 18	25.00		.90							
1891—No. 1523.	Mission San José	Oct. 1	26.40		.61							
No. 1560.	Paso Robles	Oct. 7	23.25		.62					.63		
1892—No. 1686.	Mission San José	Sept. 24	25.00		.72							
No. 1761.	Paso Robles	Oct. 11	25.90		.57		9.34	11.64	.259	.59	.50	3.25
No. 1661.	Amador station	Sept. 16	24.85		.72							
1893—No. 1835.	Amador station	Sept. 8	20.20		1.24	.24			.330	.88		
No. 1911.	Paso Robles	Oct. 5	25.70	25.19	.71	.29	9.70	12.00	.259	.65	.59	3.30
No. 2079.	Mission San José	Nov. 2	26.20		.57				.240	.66		
No. 2114.	Cupertino	Nov. 7	32.20		.75				.611	.71		
1894—No. 2160.	Amador station	Sept. 17	26.50		.73							
No. 2261.	Mission San José	Oct. 3	25.90		.56					.58		
No. 2322.	Tulare	Oct. 13	27.20		.37							

Color Readings.

TANNAT.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1560.	Paso Robles	40.0	1VR	25.1	4VR	15.4	R	13.5	1R	15.2	3R		
1892—No. 1761.	Paso Robles	121.0	VR	83.3	VR	38.4	1VR	42.5	1VR	41.2	1VR	34.7	2-3VR
1893—No. 1835.	Amador station	40.4	2VR	41.2	2VR								
No. 1911.	Paso Robles	86.9	VR	57.1	1VR	41.2	1VR	36.4	2VR	28.6	2VR	25.5	3VR

RECORD OF TREATMENT.

No. 1302. *Tannat*, from Mission San José. Received October 7, 1890, in bad condition. The must showed 27.2% of solid contents by spindle. The grapes were fermented with No. 1303, Malbeck, in the proportion of 46 lbs. of the latter to 41 lbs. of Tannat. The fermentation lasted six days, commencing at a temperature of 66°, and attaining a maximum of 90°, on the third day.

The wine was clear in one month, but tasted and smelled of mold. It gradually improved, and at three months, after the second racking, it showed some good qualities: good flavor, some bouquet, full astringency and body, and medium acid; the moldiness was, however, still perceptible, and the lees showed a few lactic ferments; the wine was therefore pasteurized. Four months later it was bright, but a little flat. At fourteen months it had been racked four times, and was in good order, of good color and agreeable flavor, but the mold taste still persisted. At sixteen months it was bottled, but deteriorated in glass.

No. 1389. *Tannat*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 21, 1890, in poor condition, crushed and overripe. The must showed 25.0% of solid contents by spindle.

No. 1523. *Tannat*, from Mission San José. A sample for must analysis arrived October 1, 1891, in good condition. The must showed 26.4% of solid contents by spindle.

No. 1560. *Tannat*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition. The bunches were medium sized and well filled, the grapes mature. The must showed 23.25% of solid contents by spindle.

No. 1686. *Tannat*, from Mission San José. Received September 27, 1892, in good condition. The must showed 25.0% of solid contents by spindle. The grapes were fermented with No. 1685, Chauché noir, from Mission San José.

No. 1761. *Tannat*, from Paso Robles station. Received October 14, 1892, in good condition. The must showed 25.9% of solid contents by spindle. The grapes were fermented with No. 1762 and No. 1763 in the following proportions: Tannat, 28 lbs.; Cabernet Franc, 22.5 lbs.; Gros Mansenc, 19 lbs.; that is to say, 40%, 32%, 28%, respectively. The temperature of the grapes at crushing was 63°, and the maximum arrived at was 80°, on the fourth day. The wine was dry in five days.

The wine cleared quickly, and at three months, having been racked once, it was bright, of good color, smooth, and generally pleasing. It improved in keeping, and at fourteen months was mature. At fifteen months it was bottled.

No. 1661. *Tannat*, from Amador station. A sample for must analysis arrived September 19, 1892, in poor condition. The must showed 24.85% of solid contents by spindle.

No. 1835. *Tannat*, from Amador station. A sample for must analysis and for color and tannin tests was received September 8, 1893, in good condition. The bunches were of good size, well filled, but showing here and there a little coulure. The must showed 20.2% of solid contents by spindle.

No. 1911. *Tannat*, from Paso Robles station. Received October 5, 1893, in good condition. The bunches and berries were small; the grapes were very sweet and somewhat past maturity. The must showed 25.7% of solid contents by spindle. The temperature at crushing was 66°, and the maximum arrived at was 85°, on the third day. The wine was dry on the fifth day.

At three weeks the wine was nearly clear and showed full acid and astringency. At three months it had been racked twice, and was clear, full-bodied, solid, of good flavor, but very rough. Four months later it had improved, developed a good bouquet, and was in general a very good wine.

No. 2079. *Tannat*, from Mission San José. A sample for must analysis and for color and tannin tests was received November 3, 1893, in good condition. The bunches were medium to small, cylindrical, with large shoulders or small wings, close below, looser near the peduncle; the berries were small and juicy. The must showed 26.2% of solid contents by spindle.

No. 2114. *Tannat*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received November 10, 1893, in good condition. The bunches were of medium to under medium size, conico-cylindrical, with one or two small wings, close; the berries small, commencing to shrivel, but with good acid. The must showed 32.2% of solid contents by spindle.

ST. MACAIRE.

(See Vit. Rèpt. 1887-89, p. 51.)

This variety is little known outside of the locality of the same name where it is cultivated in the Bordelais. It is a fairly vigorous vine, with good foliage, somewhat liable to *oidium* and coulure, but in good soils generally producing good crops—more abundant than the Tannat or Gros Mansenc. It requires long-pruning, and has produced at Tulare, when so pruned, an average of five tons to the acre. The must generally contains less sugar than that of the Tannat or Gros Mansenc, while in acid it is about between these. It ferments well, but the wine is not so robust a keeper as that of these two varieties. The wine has a remarkably intense color, being only exceeded by the Petit Bouschet.

The average composition of the must in ordinary years is: at Cupertino, 22.3% of sugar and 0.72% of acid; at Mission San José, 22.3% of sugar and 0.84% of acid; at Tulare, 23.0% of sugar and 0.53% of acid; at the Amador station, 24.2% of sugar and 0.86% of acid. The quality of the wine is distinctly inferior to that of the Tannat or of the Gros Mansenc, but it is more deeply colored and the vines bear more abundantly. It is thus useful as a color blend in localities where Gros Mansenc will not ripen, or for the production of a fair red wine of Claret type in localities like Tulare, where color is ordinarily lacking; it also serves to increase the acid in blends requiring it.

ANALYSES OF MUSTS AND WINES.

ST. MACAIRE.		Date of Picking	MUST.				WINES.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1281.	Cupertino	Oct. 1	19.90		.99	.30	8.13	10.17	.294	.75	.53	3.08
No. 1295.	Mission San José	Oct. 1	21.95		.95	.20	8.98	11.18	.225	.77	.51	2.82
1891—No. 1443.	Tulare	Aug. 26	22.40		.50							
No. 1515.	Mission San José	Sept. 30	22.15	21.96	1.07		10.81	13.27	.301	.92	.50	2.60
1892—No. 1678.	Tulare	Sept. 18	22.73	22.23	.38	.39						
No. 1706.	Mission San José	Oct. 3	20.00	19.54	1.07	.35	8.06	10.08	.309	.86	.79	3.20
1893—No. 1827.	Amador station	Sept. 6	21.30		1.05	.21						
No. 1846.	Tulare	Sept. 12	22.00	21.22	.74	.46	8.34	10.42	.259	.65	.52	3.30
No. 2063.	Mission San José	Nov. 1	24.80	24.34	.88	.32	9.56	11.91	.243	.80	.62	3.30
No. 2116.	Cupertino	Nov. 4	25.90		.66				.524	.77		
1894—No. 2197.	Amador station	Sept. 23	27.15		.50							
No. 2205.	Tulare	Sept. 27	24.80		.52							
No. 2272.	Mission San José	Oct. 3	21.90		.70							

COLOR READINGS.

ST. MACAIRE.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1515.	Mission San José	444.0	2VR	190.0	1VR	125.0	2VR	133.3	2VR	108.0	2VR	69.0	2VR
1892—No. 1706.	Mission San José	222.0	VR	174.0	1VR	125.0	1VR	125.0	1VR	118.0	1VR	97.5	1-2VR
1893—No. 1846.	Tulare	138.0	VR	48.8	VR	38.8	1VR	36.0	1VR	31.0	2VR	30.3	2VR
No. 2063.	Mission San José	166.0	1-2VR	142.0	1VR	133.0	1-2VR	118.0	1-2VR	90.9	2VR		
No. 2116.	Cupertino	148.0	VR										

RECORD OF TREATMENT.

No. 1281. *St. Macaire*, from J. T. Doyle, Cupertino. Received October 3, 1890, in good condition but for a few moldy berries. The grapes were not mature. The must showed 19.9% of solid contents by spindle. The temperature of the grapes at crushing was 64°, and the maximum reached was 89°, on the fourth day. The fermentation lasted five days

The wine in about a month was of good quality, with full acid and astringency, but had a slight moldy taste. At three months the lees showed a little lactic filaments, but the taste was unaffected; the moldy taste was, however, still faintly perceptible. The wine was pasteurized at this date. Four months later the wine was bright and improved. At fourteen months it had been racked four times, and was in good condition and of good color; it was, however, rather flat and without much character. Some of the wine was bottled at sixteen months and some at twenty-three months. Two months after bottling the wines were tasted; the first bottled was flat and not good; the second. bright, smooth, and of good flavor, but lacking in bouquet.

No. 1295. *St. Macaire*, from Mission San José. Received October 3, 1890, in fair condition, some grapes moldy and not mature. The must showed 21.95% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum temperature reached was 87°, on the second day. In three days and a half the fermentation was through, and the wine was pressed.

In three weeks the wine was nearly clear, but tasted of mold. The wine was somewhat slow in clearing, but it remained sound and no bad ferments were found in the lees. At three months the wine had been racked twice and was clear and showed some good qualities. It improved gradually, and finally at the end of fourteen months had almost lost its moldy taste, was well flavored, sound, and with high acid. At two years it was bottled. At two months after bottling the wine was of good quality but for a faint remnant of the moldy taste.

No. 1443. *St. Macaire*, from Tulare station. A sample for must analysis arrived August 29, 1891, in good condition. The must showed 22.4% of solid contents by spindle.

No. 1515. *St. Macaire*, from Mission San José. Received October 1, 1891, in good condition. The must showed 22.15% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the maximum temperature reached was 86°, on the third day. The murk was nearly dry on the morning of the third day, and was pressed in the afternoon of the same day.

In one month from crushing, the wine was clear, highly acid and astringent, and with good aroma; at three months it had developed a good vinous bouquet, was clean-tasting, of good flavor, and generally very promising. Tastings at five and at ten months showed a gradual improvement and good keeping qualities, in spite of the smallness of the sample (five gallons). At fifteen months the wine still retained its freshness. A month later it was bottled.

No. 1678. *St. Macaire*, from Tulare station. A sample for must analysis was received September 21, 1892, in good condition. The must showed 22.73% of solid contents by spindle.

No. 1706. *St. Macaire*, from Mission San José. Received October 5, 1892, in fair condition. The must showed 20.0% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum, reached on the third day, was 88°. The murk had finished fermenting on the fourth day, and was pressed.

At three weeks after crushing the wine was clear and showed some good qualities, but had a little taste of mold. At three months it was bright, of good flavor, and with high acid and astringency. The wine remained good, but the acid continued rather harsh, and the moldy taste never quite disappeared. At eighteen months the wine was bottled.

No. 1827. *St. Macaire*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition. The bunches were of medium size and showed no coulure; the berries were of good size, not quite mature. The must showed 21.3% of solid contents by spindle.

No. 1846. *St. Macaire*, from Tulare station. Received September 15, 1893, in good condition. The bunches were of good size and loose; the berries of good size and well colored. The grapes were mature, and the must showed 22.0% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the maximum temperature of 88° was reached on the third day. The murk was nearly dry on the fourth day, and was pressed.

The wine was somewhat slow in clearing, and a nearly insensible fermentation continued for about a month. At the end of a month it was clear, but tasted flat. At three months it was bright, full-bodied, and astringent, but somewhat flat and not quite clean-tasting. At six months it had been racked twice, and was bright, but heavy and coarse.

No. 2063. *St. Macaire*, from Mission San José. Received November 1, 1893, in good condition. The bunches were of medium size, loose, irregularly conical, winged; the berries of medium size. The grapes were mature, and the must showed 24.8% of solid contents by spindle. The temperature of the grapes at crushing was 61°, and the maximum reached was 81°, on the fourth day. On the fifth day the murk was dry, and was pressed out.

At one month the wine was clear, and at three months bright, very rough, and full-bodied. At seven months it did not show very high quality, but was sound and very rich in color.

No. 2116. *St. Macaire*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received November 6, 1893, in good condition. The bunches were over medium in size, loose, irregular, branching; the berries of medium size, round, soft, thick-skinned, very ripe, but with good acid. The must showed 25.9% of solid contents by spindle.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF BORDEAUX TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Cabernet Sauvignon.										
1248	Fresno	1890	22.40	21.80	.65	.32					
1662	Amador station	1892	22.95		.57						
1820	Amador station	1893	22.70		.80	.21					
2282	Amador station	1894	25.45	23.61	.53						
1342	Mission San José	1890	22.90		.62	.26	11.36	.252		.40	2.78
1591	Mission San José	1891	25.40	24.11	.44						
1765	Mission San José	1892	21.95	21.22	.77		10.83	.199	.69	.63	2.85
1950	Mission San José	1893	22.10		.58						
2303	Mission San José	1894	29.00		.47						
1347	Cupertino	1890	24.80		.40						
1554	Paso Robles	1891	25.65		.41						
1750	Paso Robles	1892	24.80		.31						
1914	Paso Robles	1893	24.80	25.19	.53	.23	11.64			.46	3.10
1892	Tulare	1893	23.70	20.99	.37						
2207	Tulare	1894	25.50	24.12	.39						
	Average, Amador station		**23.70**	**23.61**	**.63**	**.21**					
	Average, Mission San Jose		**24.27**	**22.67**	**.57**	**.26**	**11.09**	**.225**	**.69**	**.52**	**2.82**
	Average, Paso Robles			**25.19**	**.42**	**.23**	**11.64**			**.46**	**3.10**
	Average, Tulare		**24.60**	**22.56**	**.38**						
	Cabernet Franc.										
1522	Mission San José	1891	26.95	26.31	.44						
2294	Mission San José	1894	23.20		.36						
1559	Paso Robles	1891	23.50		.58						
1782	Paso Robles	1892	22.85		.50						
2070	Paso Robles	1893	26.70	25.76	.43	.30	12.36	.262	.49	.36	3.15
	Average, Mission San Jose			**26.31**	**.40**						
	Average, Paso Robles			**25.76**	**.50**	**.30**	**12.36**	**.262**	**.49**	**.36**	**3.15**

	Merlot.										
1218	Fresno	1890	23.70		.28						
1866	Cupertino	1890	26.30		.38						
2060	Cupertino	1893	26.30		.51			.294	.74		
1380	Mission San José	1890	28.80		.40						
1586	Mission San José	1891	25.90	24.96	.36	.44					
1993	Mission San José	1893	25.90		.58			.451	.68		
2259	Mission San José	1894	23.70		.49						
1965	Paso Robles	1893	28.40	28.33	.29	.33		.326	.41		
	Average, Cupertino		**26.30**		**.44**			**.294**	**.74**		
	Average, Mission San Jose		**26.07**	**24.96**	**.46**	**.44**		**.451**	**.68**		
	Malbeck.										
1303	Mission San José	1890	24.55		.56	.38					
2274	Mission San José	1894	22.60		.50						
1321	Cupertino	1890	25.20		.53						
2055	Cupertino	1893	25.20		.62			.384	.90		
1475	Fresno	1891	25.00	24.64	.55	.51					
1489	Paso Robles	1891	28.80	29.07	.54						
1653	Paso Robles	1892	22.15	21.80	.53	.34					
1917	Paso Robles	1893	26.30	24.64	.50	.38	12.20	.272	.48	.44	3.30
1665	Amador station	1892	24.25		.58						
1817	Amador station	1893	21.50	20.99	.78	.26		.294	.72		
1679	Tulare	1892	22.80		.44						
1797	Tulare	1893	21.10	18.90	.62	.45	9.27	.298	.51	.67	3.80
2208	Tulare	1894	22.60		.53						
	Average, Mission San Jose		**23.58**		**.53**	**.38**					
	Average, Cupertino		**25.13**	**24.64**	**.57**	**.51**		**.384**	**.90**		
	Average, Paso Robles		**25.75**	**25.12**	**.52**	**.36**	**12.20**	**.272**	**.48**	**.44**	**3.30**
	Average, Amador station		**22.88**	**20.99**	**.68**	**.26**		**.294**	**.72**		
	Average, Tulare		**22.13**	**18.90**	**.53**	**.45**	**9.27**	**.298**	**.51**	**.67**	**3.80**
	Verdot.										
1223	Fresno	1890	23.70	23.62	.57	.33					
1250	Fresno	1890	24.10	23.62	.57	.27					
1331	Cupertino	1890	21.05		.92						
2043	Cupertino	1893	25.70		1.10			.355	.94		
2115	Cupertino	1893	26.30		1.15			.400	.79		
2124	Cupertino	1893	25.70		1.01						
1382	Mission San José	1890	25.00		.99	.23	12.36	.320		.39	3.32
1592	Mission San José	1891		24.11	.82	.40	11.91	.291	.67	.49	3.20
1991	Mission San José	1893	24.10		.92			.425	.85		
2306	Mission San José	1894	25.00		.64						
1551	Paso Robles	1891	23.40		.39						

Summary of Analyses of Musts and Wines of Bordeaux Type—Continued.

Number	Locality.	Vintage of	Must.				Wine.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid (as Tartaric)	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Verdot—Continued.										
1726	Paso Robles	1892	25.90		.48						
1736	Paso Robles	1892	20.60		.53						
1935	Paso Robles	1893	26.95	26.24	.49	.31		.534	.41		
1681	Tulare	1892	23.70		.39						
1942	Tulare	1893	22.35	21.38	.63	.23		.438	.56		
2317	Tulare	1894	26.00		.47						
1828	Amador station	1893	21.50		1.23			.386	1.13		
	Average, Fresno		**23.90**	**23.62**	**.57**	**.30**					
	Average, Cupertino		**24.69**		**1.04**			**.377**	**.86**		
	Average, Mission San Jose		**24.52**		**.84**	**.32**	**12.13**	**.345**	**.76**	**.44**	**3.26**
	Average, Paso Robles			**26.24**	**.47**	**.31**		**.534**	**.41**		
	Average, Tulare		**24.02**	**21.38**	**.49**	**.23**		**.438**	**.56**		
	Gamai Teinturier.										
1228	Fresno	1890	25.40	25.76	.64	.40					
1276	Cupertino	1890	21.93		.80	.23	11.45	.202	.84	.52	2.58
2128	Cupertino	1893	26.50		.68			.349	.71		
1580	Mission San José	1891	26.80	26.99	.65		13.73	.307	.75	.50	2.70
1684	Mission San José	1892	24.10		.93		14.82	.232	.84	.86	3.10
1945	Mission San José	1893	23.20		.87			.428	.86		
2265	Mission San José	1894	25.65		.80						
1663	Amador station	1892	25.86		.58						
1823	Amador station	1893	20.20		.88			.253	1.00		
1866	Paso Robles	1893	23.05	20.99	.68	.24	10.58	.122	.56	.55	2.95
1893	Tulare	1893	26.90	24.12	.64	.40		.317	.71		
	Average, Cupertino		**24.22**		**.74**	**.23**	**11.45**	**.275**	**.78**	**.52**	**2.58**
	Average, Mission San Jose			**26.99**	**.81**		**12.78**	**.322**	**.82**	**.68**	**2.90**
	Average, Amador station		**23.03**		**.73**			**.253**	**1.00**		

	Teinturier.										
1205	Fresno	1890	24.55	24.43	.48	.54	11.64	.210	.46	.38	3.20
1235	Fresno	1890	22.00	21.80	.71	.43	-----	-----	-----	-----	-----
1283	Cupertino	1890	25.20	-----	.70	.32	12.36	.359	.54	.32	3.28
2121	Cupertino	1893	26.10	-----	.50	-----	-----	.531	-----	-----	-----
1292	Mission San José	1890	23.60	-----	.80	.21	11.64	.310	.71	.37	2.78
1521	Mission San José	1891	25.90	25.19	.60	-----	12.13	.311	.74	.59	3.05
1587	Mission San José	1891	27.55	26.99	.55	-----	-----	-----	-----	-----	-----
1710	Mission San José	1892	25.00	-----	.70	.32	-----	-----	-----	-----	-----
1946	Mission San José	1893	25.90	-----	.85	-----	-----	.547	.83	-----	-----
2271	Mission San José	1894	22.70	-----	.53	-----	-----	.305	-----	-----	-----
1497	Paso Robles	1891	21.50	20.99	.57	.33	10.00	.100	.53	.53	3.05
1666	Amador station	1892	26.25	-----	.56	-----	-----	-----	-----	-----	-----
1831	Amador station	1893	23.70	-----	.60	-----	-----	.361	.75	-----	-----
2196	Amador station	1894	28.00	-----	.33	-----	-----	-----	-----	-----	-----
1943	Tulare	1893	23.45	-----	.74	-----	-----	-----	-----	-----	-----
2151	Tulare	1894	24.55	-----	.57	-----	-----	-----	-----	-----	-----
	Average, Fresno	-----	**23.27**	**23.11**	**.59**	**.48**	**11.64**	**.210**	**.46**	**.38**	**3.20**
	Average, Cupertino	-----	**25.65**	-----	**.60**	**.32**	**12.36**	**.445**	**.54**	**.32**	**3.28**
	Average, Mission San Jose	-----	-----	**26.08**	**.67**	**.26**	**11.93**	**.310**	**.72**	**.48**	**2.91**
	Average, Amador station	-----	**25.98**	-----	**.49**	-----	-----	**.361**	**.75**	-----	-----
	Average, Tulare	-----	**24.00**	-----	**.65**	-----	-----	-----	-----	-----	-----
	Charbono.										
1536	Paso Robles	1891	24.15	-----	.34	-----	-----	-----	-----	-----	-----
1730	Paso Robles	1892	20.00	-----	.51	-----	-----	-----	-----	-----	-----
1934	Paso Robles	1893	23.10	21.63	.48	.34	10.58	.218	.45	.41	3.10
1623	Tulare	1892	24.15	-----	.44	-----	-----	-----	-----	-----	-----
1844	Tulare	1893	20.85	18.84	.49	.48	9.54	.141	-----	.49	3.20
2212	Tulare	1894	24.40	-----	.41	-----	-----	-----	-----	-----	-----
1824	Amador station	1893	19.30	-----	.74	-----	-----	.320	.80	-----	-----
2283	Amador station	1894	24.80	24.12	.44	-----	-----	-----	-----	-----	-----
	Average, Paso Robles	-----	**22.42**	**21.63**	**.44**	**.34**	**10.58**	**.218**	**.45**	**.41**	**3.10**
	Average, Tulare	-----	**23.13**	**18.84**	**.45**	**.48**	**9.54**	**.141**	-----	**.49**	**3.20**
	Average, Amador station	-----	-----	**24.12**	**.59**	-----	-----	**.320**	**.80**	-----	-----
	Tannat.										
1302	Mission San José	1890	27.20	-----	.63	.28	-----	-----	-----	-----	-----
1523	Mission San José	1891	26.40	-----	.61	-----	-----	-----	-----	-----	-----
1686	Mission San José	1892	25.00	-----	.72	-----	-----	-----	-----	-----	-----
2079	Mission San José	1893	26.20	-----	.57	-----	-----	.240	.66	-----	-----
2261	Mission San José	1894	25.90	-----	.56	-----	-----	-----	.58	-----	-----
1389	Cupertino	1890	25.00	-----	.90	-----	-----	-----	-----	-----	-----
2114	Cupertino	1893	32.20	-----	.75	-----	-----	.611	.71	-----	-----

SUMMARY OF ANALYSES OF MUSTS AND WINES OF BORDEAUX TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Tannat—Continued.										
1560	Paso Robles	1891	23.25		.62				.63		
1761	Paso Robles	1892	25.90		.57						
1911	Paso Robles	1893	25.70	25.19	.71	.29	12.00	.259	.65	.59	3.30
1661	Amador station	1892	24.85		.72						
1835	Amador station	1893	20.20		1.24	.24		.330	.88		
2160	Amador station	1894	26.50		.73						
2322	Tulare	1894	27.20		.37						
	Average, Mission San Jose		**26.14**		**.62**	**.28**		**.240**	**.62**		
	Average, Cupertino		**33.60**		**.82**			**.611**	**.71**		
	Average, Paso Robles			**25.19**	**.67**	**.29**	**12.00**	**.259**	**.64**		**3.30**
	Average, Amador station		**23.85**		**.89**	**.24**		**.330**	**.88**		
	St. Macaire.										
1281	Cupertino	1890	19.90		.99	.30	10.17	.294	.75	.53	3.08
2116	Cupertino	1893	25.90		.66			.524	.77		
1295	Mission San José	1890	21.95		.95	.20	11.18	.225	.77	.51	2.82
1515	Mission San José	1891	22.15	21.96	1.07		13.27	.301	.92	.50	2.60
1706	Mission San José	1892	20.00	19.54	1.07	.35	10.08	.309	.86	.79	3.20
2063	Mission San José	1893	24.80	24.34	.88	.32	11.91	.243	.80	.62	3.30
2272	Mission San José	1894	21.90		.70						
1443	Tulare	1891	22.40		.50						
1678	Tulare	1892	22.73	22.23	.38	.39					
1846	Tulare	1893	22.00	21.22	.74	.46	10.42	.259	.65	.52	3.30
2205	Tulare	1894	24.80		.52						
1827	Amador station	1893	21.30		1.05	.21					
2197	Amador station	1894	27.15		.50						
	Average, Cupertino		**22.90**		**.82**	**.30**	**10.17**	**.409**	**.76**	**.58**	**3.08**
	Average, Mission San Jose			**24.34**	**.79**	**.32**	**11.91**	**.243**	**.80**	**.62**	**3.30**
	Average, Tulare		**22.98**	**21.72**	**.53**	**.43**	**10.42**	**.259**	**.65**	**.52**	**3.30**
	Average, Amador station										

RED RHENISH TYPE.

The most noted of the German red wines, the wines of Ingelheim and Asmannshausen, are the product of the Blaue Burgunder or Pinot, which have been discussed under the Burgundy varieties. The light wines of Affenthal are made from the Affenthaler or Blaue Arbst, and resemble the wines of Bordeaux more than those of Burgundy. The grapes contain only a moderate amount of sugar, and full acid. The wine is light and of good color.

There are two varieties known in Germany under the name of Affenthaler. The one growing at the stations seems to be that which goes also under the name of Blaue Arbst, and is superior to the other in all but bearing qualities. It is very promising for California, and makes a wine of high quality, less rough and less marked in aroma than that of the best Medoc varieties, but of excellent character, and of good fermenting and keeping qualities.

AFFENTHALER.

(See Vit. Rept. 1887-89, p. 86.)

Further experiments with the Affenthaler show it to be one of the varieties capable of producing a red wine of high quality in California. The vine, though bearing some superficial resemblance to the Pinot, is certainly not identical with any variety of Pinot, as is stated by some ampelographers; and still less with Trollinger, as stated by others. The character of the wine allies it much more closely with the Bordeaux varieties than with the Burgundy. The variety, as it grows in California, does not correspond perfectly with the descriptions in European works, but differs only in particulars which may be due to climatic causes. The following description is drawn from the vines growing in the Mission San José experimental plot: The leaves are of medium size, circular in outline, obtusely dentate with mucronate teeth alternately small and large; upper sinuses very shallow, lower none, petiolar sinus deep and narrow; the bunches are of medium size, conical, winged, well filled, but not compact; the berries are small, round, thin-skinned, juicy. At the Amador station the grapes have thicker skin, and at all the stations the leaves have much less indument than the European specimens are credited with.

The success of this variety at Fresno proves that the original habitat of a vine cannot always be taken as indicating infallibly the localities where it will be of use and where it will not. It did not bear heavily at Fresno, but it bore as well as any variety producing a wine of high quality. No. 1460, Affenthaler, from Fresno, was a wine of high body, astringency, and vinosity, with good flavor, color, and excellent keeping qualities. It was, perhaps, of higher quality than any wine made at this station from Fresno grapes. With 0.48% of acid the must averaged 24.80% of sugar, and fermented thoroughly and without difficulty. Unfortunately, the vine has not yet been tested at Tulare. At Mission San José and at Cupertino the Affenthaler has borne fairly well and has produced an excellent wine of good keeping qualities, slow to mature, less acid than the Italian varieties, but with greater delicacy. At Paso Robles the composition of the must has shown a slight deficiency in acid, and the vines have not borne well enough to allow of a wine-making test. At the Amador station the vine is a moderate grower and fair bearer, but has not yet been sufficiently tested.

AFFENTHALER.		Date of Picking.	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1237.	Fresno	Aug. 23	24.10	23.62	.48	.30						
No. 1313.	Cupertino	Oct. 8	21.50		.62	.25	8.84	11.00	.229	.55	.36	2.70
No. 1417.	Mission San José	Oct. 28	25.50		.72	.22	11.31	13.82	.313	.70	.48	3.08
1891—No. 1460.	Fresno	Aug. 29	24.80		.48		9.70	12.09	.350	.54	.49	3.35
No. 1541.	Paso Robles	Oct. 6	25.00		.34							
No. 1571.	Mission San José	Oct. 7	21.95		.77					.68		
No. 1583.	Mission San José	Oct. 13	23.90	22.67	.63		9.56	11.91	.350	.68	.54	3.05
1892—No. 1646.	Paso Robles	Sept. 13	22.60		.73							
No. 1757.	Paso Robles	Oct. 11	23.90		.42							
No. 1793.	Mission San José	Oct. 18	22.60		.72		9.05	11.27	.212		.72	2.65
1893—No. 1804.	Amador station	Sept. 1	21.10		.93							
No. 1885.	Paso Robles	Sept. 21	22.20		.39							
No. 1984.	Mission San José	Oct. 19	24.80	23.91	.71		9.34	11.64	.290	.68	.66	3.10
No. 2132.	Cupertino	Nov. 1	26.30		.54				.365			
1894—No. 2147.	Amador station	Sept. 13	26.50		.61							
No. 2304.	Mission San José	Oct. 12	22.80		.56				.183			

Color Readings.

AFFENTHALER.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1460.	Fresno	24.7	4VR	22.2	5VR	12.4	1-2R	11.4	1R	14.3	R	12.3	1R
No. 1571.	Mission San José	93.0	VR	27.0	2VR	16.5	4VR	16.5	5VR	11.2	R		
No. 1583.	Mission San José	108.0	VR-1VR	80.0	VR-1VR	66.6	1VR	40.0	1VR	40.8	1VR		
1893—No. 1984.	Mission San José	86.9	VR	58.8	VR-1VR	50.6	1VR	46.0	1VR	36.0	2VR	29.8	3VR
No. 2132.	Cupertino	48.2	2VR										
1894—No. 2304.	Mission San José	51.3	1-2VR										

RECORD OF TREATMENT.

No. 1237. *Affenthaler*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, and mature. The must showed 24.1% of solid contents by spindle and 0.48% of acid.

No. 1313. *Affenthaler*, from Cupertino. Received October 10, 1890, in good condition, and mature. The must showed 21.5% of solid contents by spindle and 0.62% of acid. The temperature of the 192 pounds crushed was 64°, and the maximum reached was 86°, on the fourth day. On the fifth day the wine was still a little sweet, and on the sixth day it was drawn off.

In three weeks the wine was clear, and showed high astringency. At six weeks an examination of the lees showed them to be sound, and the wine was bright, with some aroma and pleasant flavor, clean taste, and medium acid. At three months the lees were examined, and found to contain some *S. pastorianus* and a few acetic germs; the wine was bright, developing well, and was racked for the second time. At five and at six months the lees were examined again, and showed an increase of the *S. pastorianus* and still a little acetic taste; the wine was bright, with good flavor, and had developed a good bouquet, but was still rough. At eight months the lees showed no injurious ferments. At fifteen months the wine was bright, with good ruby color, rich bouquet and flavor, clean taste, and of high vinosity; it was a wine of high quality, and was mature. Two months later it was racked, and part put in bottle. The rest was bottled at twenty-three months. At three years and three months the wine bottled at seventeen months was bright, in first-class order, and of high quality; the wine bottled later had not kept so well.

No. 1417. *Affenthaler*, from Mission San José. Received October 30, 1890, in fair condition, and mature. The must showed 25.5% of solid contents by spindle and 0.72% of acid. The grapes (116 pounds) were crushed the day after arrival, at a temperature of 66°; reached a maximum of 87° on the third day. The wine was dry on the sixth day, when it was drawn off.

At one month the wine was clear, showed good flavor and aroma, medium acid, high astringency, was of good quality, and still slightly sweet. At three months a microscopical examination of the lees showed them to be sound, and the wine was racked for the second time. The wine was clear, with good bouquet and flavor—a very agreeable wine, but with a trace of sugar. At five months the lees showed a few filaments, and the wine was pasteurized. It was bright, but still a little sweet, and the taste was slightly affected by secondary fermentation. At eight months it was racked for the third time, and at twelve months had lost all its sweetness; it was clear, and still showed good quality, but it had deteriorated. It was bottled, but did not keep well in bottle.

No. 1460. *Affenthaler*, from Fresno. Received August 31, 1891, in good condition. The must showed 24.8% of solid contents by spindle and 0.48% of acid. The grapes weighed 50.25 pounds, and were crushed on the day they were received. The temperature of the must at crushing was 66° and the maximum of 83° was reached on the fifth day. The wine was still a little sweet on the eighth day, when it was drawn off.

At three weeks the wine was very rough and astringent, cloudy, but quite dry. At six weeks it was bright, with good aroma and full and pleasing flavor. At two months it was racked. At four months it was bright, a very good wine, much softened down, and nearly mature (there were only two gallons). Tastings at six and at eight months showed that the wine retained its good quality, and had improved. At eight months it was put in glass. At three years and a half it was bright, with well-settled deposit, lacking in bouquet, but of very good flavor, smooth, clean-tasting, and of good and sufficient color.

No. 1541. *Affenthaler*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in fair condition. The grapes were thin-skinned, somewhat crushed, and mature. The must showed 25.0% of solid contents by spindle and 0.34% of acid.

No. 1571. *Affenthaler*, from Mission San José. A sample for must analysis and color test was received October 9, 1891, in good condition. The must showed 21.95% of solid contents by spindle and 0.77% of acid.

No. 1583. *Affenthaler*, from Mission San José. Received October 16, 1891, in fair condition. The must showed 23.9% of solid contents by spindle, and 0.63% of acid. There were 159 pounds, which were crushed at a temperature of 70°. The maximum temperature, reached on the third day, was 91°. On the fourth day the wine was dry, and was drawn off.

At one month the wine was clear, very rough, and showed some aroma. At five months it was bright, an excellent, very solid wine, but with little bouquet. At ten months it was racked for the third time. The lees were examined at one, four, and five months, but no unsound ferments were found. At sixteen months the wine was in good order, had developed some bouquet, was of good quality, but slightly bitter. At eighteen months it was racked, and part bottled; at twenty-two months the rest was bottled. At two years and four months the bottled wine was tasted; both bottlings were bright and of good color; that last bottled had been injured by remaining too long in a small keg; the second bottling was a full, generous wine, with some bouquet and of full flavor, but too rough and not aged enough in wood.

No. 1646. *Affenthaler*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 22.6% of solid contents by spindle and 0.73% of acid.

No. 1757. *Affenthaler*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 23.9% of solid contents by spindle and 0.43% of acid.

No. 1793. *Affenthaler*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 22.6% of solid contents by spindle and 0.72% of acid. The 131.5 pounds were crushed at a temperature of 63°, and reached a maximum of 87° on the third day. The wine was nearly dry on the fourth day, and was drawn off on the fifth.

In one month the wine was clear, and was racked and taken to the cellar. At three months it was bright, clean-tasting, with high acid and astringency, some bouquet and flavor; in general, a very agreeable wine. At five months it was in good order, faintly sweet, but sound. It was racked for the second time, and at eight months was quite dry, but still raw. At ten months it was still very rough and astringent, but promising. Four months later it had improved, but was not mature. At eighteen months it was bottled.

No. 1804. *Affenthaler*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition. The bunches were of medium size, compact; the berries small and thick-skinned. The must showed 21.1% of solid contents by spindle and 0.93% of acid.

No. 1885. *Affenthaler*, from Paso Robles station. A sample for must analysis was received September 21, 1893, in good condition. The bunches were small and loose; the berries soft, thin-skinned, with some flavor, and mature. The must showed 22.2% of solid contents by spindle and 0.39% of acid.

No. 1984. *Affenthaler*, from Mission San José. Received October 19, 1893, in good condition. The bunches were of medium size, conical, winged, well filled, but not compacted; the berries were small, round, thin-skinned, juicy, mature. The must showed 24.8% of solid contents by spindle and 0.71% of acid. The 115 pounds were crushed at a temperature of 60°, and attained a maximum of 88° on the third day. The wine was dry on the fifth day, and was drawn off on the sixth.

At one month the wine was clear, but extremely rough. It was racked and taken to the cellar, and at three months was bright, with very marked acid and astringency, full and agreeable bouquet and flavor, a wine of good promise. At four months it was racked for the second time, and at seven months it had improved, but was still very rough and showed excellent keeping qualities. At ten months the lees showed *S. pastorianus;* the wine was in good order, but still very rough. A month later it was racked and in part bottled. At sixteen months the wine was in good order, improved in bouquet and flavor, of clean taste, a full, rich wine, but not quite mature. A month later it was bottled.

No. 2132. *Affenthaler*, from Cupertino. A sample for must analysis was received November 3, 1893, in good condition. The bunches were small, conico-cylindrical, compact; the berries were small, shriveled, much overripe, but with a fresh taste. The must showed 26.3% of solid contents by spindle and 0.54% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF RED RHENISH TYPE.

Number	Locality	Vintage of	Must: Solid Contents by Spindle	Must: Sugar by Copper Test	Must: Acid as Tartaric	Must: Ash	Wine: Alcohol by Volume	Wine: Tannin	Wine: Total Acid as Tartaric, At Pressing	Wine: Total Acid as Tartaric, At 6 to 8 Months	Body
	Affenthaler.										
1237	Fresno	1890	24.10	23.62	.48	.30					
1460	Fresno	1891	24.80		.48		12.09	.350	.54	.49	3.35
1313	Cupertino	1890	21.50		.62	.25	11.00	.229	.55	.36	2.70
2132	Cupertino	1893	26.30		.54			.365			
1417	Mission San José	1890	25.50		.72	.22	13.82	.313	.70	.48	3.08
1571	Mission San José	1891	21.95		.77				.68		
1583	Mission San José	1891	23.90	22.67	.63		11.91	.350	.68	.54	3.05
1793	Mission San José	1892	22.60		.72		11.27	.212		.72	2.65
1984	Mission San José	1893	24.80	23.91	.71		11.64	.290	.68	.66	3.10
2304	Mission San José	1894	22.80		.56			.183			
1541	Paso Robles	1891	25.00		.34						
1646	Paso Robles	1892	22.60		.73						
1757	Paso Robles	1892	23.90		.42						
1885	Paso Robles	1893	22.20		.39						
1804	Amador station	1893	21.10		.93						
2147	Amador station	1894	26.50		.61						
	Average, Fresno		24.45	23.62	.48	.30	12.09	.350	.54	.49	3.35
	Average, Cupertino		23.90		.58	.25	11.00	.297	.55	.36	2.70
	Average, Mission San Jose		24.25	23.29	.63	.22	12.16	.269	.68	.60	2.97
	Average, Paso Robles		23.42		.47						
	Average, Amador station		23.85		77						

RED BURGUNDY TYPE.

(For further description, see Vit. Rept. 1887-89, p. 89.)

Notwithstanding the general failure of the Burgundy grapes proper (the Pinots) in California, there are some very good as well as some very bad wines which are sold here under the name of Burgundies. They have, however, very seldom much resemblance to the Burgundies of France, and in fact differ so much among themselves that there is not even a type of wine which could be called California Burgundy. The reason for the repeated failures to make and keep good Pinot wines is doubtless to be looked for in the lack of proper methods and care in fermentation. The Bordeaux and Italian varieties have given universally so much better results than those of Burgundy that the latter are being almost entirely abandoned; but with proper control of temperature, and exclusion of injurious germs during fermentation and the first months of keeping, we shall doubtless be able to make as good or better wines of the more delicate Pinots. It is very much to be desired that this should be done, for the American and English taste prefers, in general, the smooth Burgundy type to the somewhat harsher Clarets.

PINOTS.

(See Vit. Rept. 1885-86, p. 77; 1887-89, p. 90.)

The latest investigations of this group of grapes confirm the opinions expressed in the last Viticultural Report. Under the conditions of wine-making in California, it is next to impossible to make and keep a perfectly sound wine of Pinots alone. In some localities it is doubtless possible to make a Pinot wine of high quality and to age it, but only with a minute attention to detail and an elaborate care, which no price that is likely to be obtained at present would justify. The grapes would have to be picked at exactly the right degree of ripeness, handled with the greatest care to avoid breaking the berries, and then fermented and kept in a perfect cellar, where the conditions of temperature, ventilation, and cleanliness were under perfect control.

Nearly all the Pinot wines made at the experimental cellar have been injured by secondary fermentations, principally on account of the poor condition in which the grapes have been received, it being almost impossible to ship such delicate grapes without crushing them and allowing them to become attacked by injurious organisms, before they can be put into the fermenting-vat. For the hot interior localities the Pinots must be unhesitatingly rejected. In the cooler localities of the Coast Range they may be utilized by blending in the fermenting-vat with some more acid and more robust variety, such as the Gamai Teinturier, but with some sacrifice of their smooth Burgundy character. Their juice has entered into the composition of some of the best champagne wines made in this State.

ANALYSES OF MUSTS AND WINES.

PINOTS.		Varieties.	Date of Picking.	MUST.				WINE.					
				Solid Contents by Spindle.	Sugar by Copper Test.	Acid as Tartaric.	Ash.	Alcohol. By Weight.	Alcohol. By Volume.	Tannin.	Total Acid as Tartaric. At Pressing.	Total Acid as Tartaric. At Six Months.	Body.
1890—No. 1219.	Fresno	Blauer Burgunder	Aug. 22	21.50	21.38	.69	.39						
No. 1224.	Fresno	Pinot de St. George	Aug. 22	25.00	25.19	.62	.55						
No. 1232.	Fresno	Blauer Burgunder	Aug. 23	25.40	24.64	.42	.38						
No. 1258.	Mission San José	Pinot (mixed)	Sept. 24	24.80		.65	.31	9.92	12.36	.102	.54	.38	3.10
No. 1325.	Cupertino	Franc Pinot	Oct. 11	26.30		.54							
No. 1332.	Cupertino	Pinot de St. George	Oct. 11	25.75		.81							
No. 1374.	Cupertino	P. Noirien	Oct. 14	27.80		.57							
No. 1392.	Cupertino	Blauer Burgunder	Oct. 19	29.70		.34							
1891—No. 1437.	Tulare	Blauer Burgunder	Aug. 24	23.60		.39							
No. 1484.	Paso Robles	Pinot de St. George	Sept. 1	19.70		.54							
No. 1506.	Mission San José	Franc Pinot	Sept. 27	25.00	24.64	.61							
No. 1508.	Mission San José	Pinot de St. George	Sept. 27	25.00	24.64	.53	.39						
No. 1588.	Mission San José	Blauer Burgunder	Oct. 14	28.00	28.32	.54							
1892—No. 1624.	Tulare	Pinot de St. George	Aug. 29	22.15		.37							
No. 1638.	Mission San José	"Pinots"	Sept. 10	22.70		.75		9.20	11.45	.189	.64	.63	2.70
No. 1744.	Paso Robles	Pinot de St. George	Oct. 11	21.10		.34							
1893—No. 1809.	Amador station	Franc Pinot	Sept. 1	23.30		.56				.230	.53		
No. 1819.	Amador station		Sept. 6	22.80	22.33	.53		9.05	11.27	.189	.49	.86	3.30
No. 1910.	Paso Robles	Pinot de St. George	Oct. 5	23.50	23.71	.41		7.99	10.00	.138	.44	.35	2.40
No. 2005.	Tulare	Pinot de St. George	Oct. 23	23.10	21.80	.32							
No. 2064.	Mission San José	Pinot de St. George	Nov. 2	28.60	27.65	.47				.262			
No. 2077.	Mission San José	Franc Pinot	Nov. 3	28.30	26.99	.48		10.81	13.27	.150	.61	.50	3.20
1894—No. 2263.	Mission San José	Pinot de St. George	Oct. 5	22.20		.74				.173			
	Pinot de Pernand.												
1890—No. 1226.	Fresno		Aug. 23	24.55	24.22	.54	.46						
No. 1367.	Cupertino		Oct. 14	25.90		.75							
1891—No. 1480.	Paso Robles		Sept. 1	21.30	17.70	.48							
No. 1504.	Mission San José		Sept. 24	24.55	23.62	.53	.32	9.63	12.09	.210	.50	.44	3.34
1892—No. 1702.	Tulare		Sept. 27	26.90		.39							
1893—No. 1799.	Tulare		Aug. 31	23.30		.67							

ANALYSES OF MUSTS AND WINES—Continued.

PINOTS.	Varieties.	Date of Picking	MUST.			WINE.						
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
Pinot de Pernand—Continued.												
1893—No. 1867. Paso Robles		Sept. 15	22.60	20.61	.47	.31			.102			
1894—No. 2152. Tulare		Sept. 17	22.60		.57							
No. 2270. Mission San José		Oct. 5	25.20		.46				.175			

COLOR READINGS.

PINOTS.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1892—No. 1638. Mission San José	48.8	2VR	28.4	5VR	21.7	R	17.4	1R	17.6	1R	15.8	R	14.2	1R
1893—No. 1809. Amador station	9.0	3R+Y	9.7	R+Y										
No. 1819. Amador station	12.9	3VR+Y	16.3	VR+Y	12.1	(Y)	12.1	(Y)						
No. 1910. Paso Robles	38.0	VR	9.6	R	9.3	R	8.3	R	3.8	3R+Y				
No. 2064. Mission San José	35.7	5VR												
No. 2077. Mission San José	26.3	4VR	18.1	R	15.0	R	13.3	R	5.9	Y				
1894—No. 2263. Mission San José	19.1	1R												
Pinot de Pernand.														
1891—No. 1504. Mission San José	37.0	5VR	19.2	5VR	14.1	1R	14.0	1R	14.6	3R				
1893—No. 1867. Paso Robles	12.4	1R	10.3	3R										
1894—No. 2270. Mission San José	52.0	1VR												

RECORD OF TREATMENT.

No. 1219. *Blauer Burgunder*, from Fresno. A sample for must analysis was received August 25, 1890, in poor condition—crushed, overripe, and some of the berries dried. The must showed 21.5% of solid contents by spindle and 0.69% of acid.

No. 1224. *Pinot St. George*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, but overripe. The must showed 25.0% of solid contents by spindle and 0.62% of acid.

No. 1232. *Blauer Burgunder*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, but overripe, and with some dried berries. The must showed 25.4% of solid contents by spindle and 0.42% of acid.

No. 1258. *Pinots* (mixed), from Mission San José. Received September 26, 1890, in fair condition, but somewhat bruised on account of loose packing. The grapes were very unevenly ripened; most of the bunches were mature, but some were unripe. The must showed 24.8% of solid contents by spindle and 0.65% of acid. The grapes, which consisted of Pinot de Pernand, Pinot St. George, and Pinot Noirien, were crushed on the day after arrival and fermented with some Meunier in the proportion of: Pinots, 250 lbs., and Meunier, 84.5 lbs. The temperature of the must was 67°, and the maximum reached was 97°, on the fourth day. On the fifth day the murk was nearly dry, and was drawn off.

The wine remained cloudy, and fermented slightly for a month, though at the end of that time no sugar was perceptible to the taste. At two months the lees were well settled, and a microscopic examination showed no unsound ferments. At this stage the wine was clear, but still giving off carbonic gas; it was of medium acid, low astringency, and good body, had a bitter after-taste, and was undeveloped and flat. A week later it was racked for the second time, and at four months it was still clear, but had a suspicious smell. An examination of the lees showed filaments, so the wine was pasteurized. Three months after pasteurizing it was bright, the unpleasant odor had almost disappeared, and the wine was light, smooth, and of fair quality. Two months later it was racked again, and at fifteen months it was bright, of poor color and bouquet, of fair flavor, and quite mature. Two months later it was racked and part put in glass. At twenty-five months the rest was bottled. Both samples deteriorated in the bottles, on account of secondary fermentations.

No. 1325. *Franc Pinot*, from Cupertino. A sample for must analysis was received October 13, 1890, in fair condition and quite mature. The must showed 26.3% of solid contents by spindle and 0.54% of acid.

No. 1332. *Pinot St. George*, from Cupertino. A sample for must analysis was received October 13, 1890, in good condition, but with some dried grapes. The must showed 25.75% of solid contents by spindle and 0.81% of acid.

No. 1374. *Pinot Noirien*, from Cupertino. A sample for must analysis was received October 17, 1890, in fair condition, a few berries moldy and some dried. The must showed 27.8% per cent of solid contents by spindle and 0.57% of acid.

No. 1392. *Blauer Burgunder*, from Cupertino. A sample for must analysis was received October 21, 1890, in bad condition; some berries moldy, and many shriveled and overripe. The must showed 29.7% of solid contents by spindle and 0.34% of acid.

No. 1437. *Blauer Burgunder*, from Tulare station. A sample for must analysis was received August 27, 1891, in good condition. The must showed 23.6% of solid contents by spindle and 0.39% of acid.

No. 1484. *Pinot St. George*, from Paso Robles station. A sample for must analysis was received September 1, 1891, in good condition. The must showed 19.7% of solid contents by spindle and 0.54% of acid.

No. 1506. *Franc Pinot*, from Mission San José. Received September 27, 1891, in poor condition. The must showed 25.0% of solid contents by spindle and 0.61% of acid. The grapes were mixed with No. 1507, Meunier, and No. 1508, Pinot St. George, in the following proportions: Franc Pinot, 70 lbs.; Meunier, 59.5 lbs.; Pinot St. George, 45.25 lbs. The temperature of the grapes at crushing was 67°, and the maximum reached was 97°, on the third day. On the fourth day, when the murk was still a little sweet and fermenting slowly, it was drawn off.

At one month the wine was nearly clear, dry but flat, though somewhat better than the Pinot de Pernand. The lees were examined, and were apparently sound, but a month later the taste was a little suspicious and the wine was pasteurized for safety. It was then blended with No. 1504, Pinot de Pernand.

No. 1508. *Pinot St. George*, from Mission San José. Received September 27, 1891, in poor condition. The must showed 25.0% of solid contents by spindle, and 0.53% of acid. The grapes were mixed with No. 1506.

No. 1588. *Blauer Burgunder*, from Mission San José. A sample for must analysis was received October 16, 1891, in poor condition. The must showed 28.0% of solid contents by spindle, and 0.54% of acid.

No. 1624. *Pinot St. George*, from Tulare station. A sample for must analysis was received September 1, 1892, in good condition. The must showed 22.15% of solid contents by spindle and 0.37% of acid.

No. 1638. *Pinots*, from Mission San José. Received September 13, 1892, in good condition, but not quite mature. The must showed 22.7% of solid contents by spindle, and 0.75% of acid. The weight of grapes crushed was 310 lbs. The temperature at crushing was 64°, and the maximum, reached on the third day, 94°. On the sixth day the wine was quite dry, and was drawn off.

At one month the wine was racked and taken to the cellar; it was dry and nearly clear. At four months it was bright, of good bouquet and flavor, fruity, clean-tasting, and sound. A little later the lees were examined and showed a little acetic taint, but no filaments. Two months later the wine was in good condition; it had kept well, and was a very good wine, with full and pleasing flavor and bouquet. At eight months it had been racked twice, and had changed little from the last tasting. After this it deteriorated, and at fifteen months was bright and of fair quality, had kept well for a Pinot, but was a little flat. At nineteen months it was bottled. At three years and a half the bottled wine was bright and showed good quality, but was not quite clean-tasting.

No. 1744. *Pinot St. George*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 21.1% of solid contents by spindle and 0.35% of acid.

No. 1809. *Franc Pinot*, from Amador station. A sample for must analysis was received September 1, 1893, in fair condition; the grapes were small and unevenly ripened, many of them were abortive and green. The must showed 23.3% of solid contents by spindle and 0.56% of acid.

No. 1819. *Pinot*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition. The bunches were small, cylindrical, compact; the berries thin-skinned and juicy. This sample was labeled Serine, but by mistake, as it was evidently a Pinot. The must showed 22.8% of solid contents by spindle and 0.53% of acid.

No. 1910. *Pinot St. George*, from Paso Robles station. Received October 5, 1893, in good condition. There were some bunches of another variety mixed with the sample. The Pinot had small bunches of very ripe and somewhat shriveled berries, the other variety had larger, firmer, and unshriveled berries. The must showed 23.5% of solid contents by spindle and 0.41% of acid. Fifty-nine pounds of grapes were crushed at a temperature of 66°. The maximum temperature reached was 82°, on the second day. The wine was dry on the fourth day, when it was drawn off.

In three weeks the wine was racked and taken to the cellar; it was nearly clear, but tasted flat. At three months it was clear, smooth, and well flavored, but lacked freshness; at four months it was racked for the second time. At seven months it had changed little; it was a fair wine, but not quite clean-tasting. At ten months it had improved, and was bright and sound, but very light in color. A month later, the quantity being so small, it was bottled.

No. 2005. *Pinot St. George*, from Tulare Station. A sample for must analysis was received October 23, 1893, in good condition. Some other grape was mixed with the Pinot. The Pinot had small, well-filled bunches of small berries, overripe, but not shriveled. The must showed 23.1% of solid contents by spindle and 0.32% of acid.

No. 2064. *Pinot St. George*, from Mission San José. A sample for must analysis was received October 31, 1893, in good condition. The bunches were small, regular, close, cylindrical, with a small wing; the berries were small, shriveled, overripe. The must showed 28.6% of solid contents by spindle and 0.47% of acid.

No. 2077. *Franc Pinot*, from Mission San José. Received November 3, 1893, in good condition. The bunches were small, compact, cylindrical, with a small shoulder; the berries were small, soft, commencing to shrivel, and much overripe. The must showed 28.3% of solid contents by spindle and 0.48% of acid. There were 89.5 lbs. crushed at a temperature of 67°. The maximum, reached on the fourth day, was 85°. The wine was nearly dry on the sixth day, when it was drawn off.

At one month, when the wine was racked and taken to the cellar, it was clear, but very bitter. At two months it was clear and of good flavor, but still bitter. After this it improved, but did not quite lose its bitterness. At ten months the wine was bottled, on account of the smallness of the sample.

No. 1226. *Pinot de Pernand*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, but overripe. The must showed 24.55% of solid contents by spindle and 0.54% of acid.

No. 1367. *Pinot de Pernand*, from Cupertino. A sample for must analysis was received October 17, 1890, in fair condition, but somewhat overripe and shriveled. The must showed 25.9% of solid contents by spindle and 0.75% of acid.

No. 1480. *Pinot de Pernand*, from Paso Robles. A sample for must analysis was received September 3, 1891, in good condition. The bunches were small; the berries were very small, not very sweet, but matured. The must showed 21.3% of solid contents by spindle and 0.48% of acid.

No. 1504. *Pinot de Pernand*, from Mission San José. Received September 27, 1891, in fair condition; a little mold. The must showed 24.55% of solid contents by spindle and 0.53% of acid. There were 101 lbs. of grapes crushed at a temperature of 67°; and the maximum temperature reached, on the third day, was 93°. On the fourth day the wine was still a little sweet and fermenting slowly, when it was drawn off.

At one month the wine was nearly clear, but tasted flat. At two months the lees showed a very few filaments and the wine tasted a little suspicious, so it was pasteurized and blended with No. 1506, Pinot from Mission San José. At six months the blend was clear, smooth, with some flavor and a little bouquet, low acid, medium astringency, fairly pleasing, but rather flat. It was racked for the third time, and again at eleven months. At seventeen months it showed improvement and had kept excellently. It was racked again at nineteen months and part bottled. At twenty-three months the rest was bottled. At three years and a half both wines were in first-class order, fresh and clean-tasting, and with excellent bouquet and full flavor. The earlier bottling was the better, was perfectly sound, and a wine of high character, the bouquet was remarkable, and the only fault it had was a slight greenness; the later bottling had a slight taint of acetic acid. Some of the wine bottled at eleven months had spoiled.

No. 1702. *Pinot de Pernand*, from Tulare station. A sample for must analysis was received September 29, 1892, overripe and badly shriveled. The must showed 26.9% of solid contents by spindle and 0.39% of acid.

No. 1799. *Pinot de Pernand*, from Tulare station. A sample for must analysis was received August 31, 1893, in good condition. The grapes were smaller than those of the average Pinot de Pernand, juicy, tasteless, the bunches well filled. The must showed 23.3% of solid contents by spindle and 0.67% of acid.

No. 1867. *Pinot de Pernand*, from Paso Robles station. A sample for must analysis was received September 15, 1893, in good condition. The grapes were mixed with a few bunches of Petit Sirah. The bunches were small, and the berries very sweet and overripe. The must showed 22.6% of solid contents by spindle and 0.57% of acid.

MEUNIER.

Synonyms: Müller traube; Miller grape.

Description.—More productive but less vigorous than the Franc Pinot; canes long, slender, trailing, often downy; young shoots very thickly covered with white down; leaves of medium size, round without sinuses, white downy on both sides, falling early; bunches small, close, short-cylindrical; berries small, round, on short pedicels, very juicy, and with rather thick skin.

The Meunier is simply one of the many variations of the ordinary Pinot. It is one of the most noticeable, on account of the abundance of white down with which it is covered. It bears rather better and is less liable to coulure and decay than the Franc Pinot, but otherwise the remarks under that variety apply equally to this.

ANALYSES OF MUSTS.

MEUNIER.		Date of Picking	MUST.				Tannin
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	
1890—No. 1212.	Fresno	Aug. 22	24.10	23.61	.41	.20	------
No. 1259.	Mission San José	Sept. 24	24.60	--------	.57	.39	------
No. 1280.	Cupertino	Oct. 1	24.55	--------	.53	.53	------
1891—No. 1507.	Mission San José	Sept. 24	25.85	25.76	.52	--------	------
No. 1558.	Paso Robles	Oct. 4	22.15	--------	.66	--------	------
1892—No. 1691.	Tulare	Sept. 26	22.40	--------	.30	--------	------
No. 1746.	Paso Robles	Oct. 11	23.50	--------	.39	--------	------
1893—No. 1808.	Amador station	Sept. 1	23.70	--------	.51	--------	------
No. 2057.	Cupertino	Nov. 1	26.70	--------	.69	--------	.304
No. 2078.	Mission San José	Nov. 4	28.00	--------	.45	--------	.329
1894—No. 2267.	Mission San José	Oct. 5	28.00	------	.45	--------	------
No. 2309.	Tulare	Oct. 10	23.70	--------	.38	--------	------

COLOR READINGS.

MEUNIER.	At Pressing.	
1893—No. 2057. Cupertino	40.0	2VR
No. 2078. Mission San José	33.6	4VR

RECORD OF TREATMENT.

No. 1212. *Meunier*, from Fresno. A sample for must analysis was received August 25, 1890, in fair condition; overripe and somewhat dried. The must showed 24.1% of solid contents by spindle and 0.41% of acid.

No. 1259. *Meunier*, from Mission San José. Received September 26, 1890, in poor condition, mature. The must showed 24.6% of solid contents by spindle and 0.57% of acid. The grapes were fermented with No. 1258, Pinot from Mission San José.

No. 1280. *Meunier*, from Cupertino. A sample for must analysis was received October 2, 1890, in fair condition. The bunches were of fair size; the berries overripe and commencing to dry up. The must showed 24.55% of solid contents by spindle and 0.53% of acid.

No. 1507. *Meunier*, from Mission San José. Received September 27, 1891, in poor condition. The must showed 25.85% of solid contents by spindle and 0.52% of acid. The grapes were fermented with No. 1506, Franc Pinot.

No. 1558. *Meunier*, from Paso Robles. A sample for must analysis was received October 8, 1891, in good condition. The bunches were small and compact; the berries small and round and much firmer than is usual with Meunier. The grapes were mature, and the must showed 22.15% of solid contents by spindle and 0.66% of acid.

No. 1691. *Meunier*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 22.4% of solid contents by spindle and 0.30% of acid.

No. 1746. *Meunier*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 23.5% of solid contents by spindle and 0.39% of acid.

No. 1808. *Meunier*, from Amador station. A sample for must analysis was received September 1, 1893, in fair condition. The grapes were small and unevenly ripened. The must showed 23.7% of solid contents by spindle and 0.51% of acid.

No. 2057. *Meunier*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were under medium size, conico-cylindrical, close; the berries small, half-dried, over-mature. The must showed 26.7% of solid contents by spindle and 0.69% of acid.

No. 2078. *Meunier*, from Mission San José. A sample for must analysis was received November 3, 1893, in fair condition, much overripe, and the berries dried up. The must showed 28.0% of solid contents by spindle and 0.45% of acid.

ROBIN NOIR.

(See Vit. Rept. 1885-86, p. 69; 1887-89, p. 108.)

The results of the tests made of this variety at the newer stations are not such as to encourage its planting in the warmer sections of the State. At Tulare the must attains high sugar contents, but is lacking in acid, and the vines expend their strength principally on the second crop. At Paso Robles the vines bear better, but the wine is not of high quality and lacks tannin. At the Amador station the vine is a moderate grower and good bearer when pruned half-long, the grapes are well flavored and with fair color; they have not yet been tested as to their wine-making qualities, but they retain fair acid with a high percentage of sugar.

ANALYSES OF MUSTS AND WINES.

ROBIN NOIR.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1230.	Fresno	Aug. 23	27.45	28.33	.43	.22	......	......	......	......	......	......
No. 1284.	Cupertino	Oct. 1	21.50	......	.81	......	......	......	......	......	......	......
No. 1428.	Mission San José	Oct. 28	24.45	......	1.05	......	......	......	......	......	......	......
1892—No. 1694.	Tulare	Sept. 26	24.80	......	.34	......	......	......	......	......	......	......
No. 1792.	Mission San José	Oct. 21	22.50	......	.91	......	......	......	......	......	......	......
1893—No. 1807.	Amador station	Sept. 1	21.75	......	.93	......	......	......	......	......	......	......
No. 1953.	Paso Robles	Oct. 15	23.70	22.23	.58	.30	9 70	12.09	.147	.60	.41	2.60
No. 1971.	Tulare	Oct. 15	24.45	24.64	.45	.51	......	......	......	......	......	......
1894—No. 2199.	Amador station	Sept. 25	28.40	......	.48	......	......	......	......	......	......	......
No. 2301.	Mission San José	Oct. 12	22.10	......	.71	......	......	......	......	......	......	......
No. 2336.	Tulare	Oct. 19	27.80	......	.34	......	......	......	......	......	......	......

COLOR READINGS.

ROBIN NOIR.		At Pressing.		One Month.		Two Months.		Three Months.	
1893—No. 1953.	Paso Robles	12.1	1R	6.8	2R	8.9	3R	4.7	1VR+Y

RECORD OF TREATMENT.

No. 1230. *Robin noir*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, but somewhat dried and over-mature. The must showed 27.45% of solid contents by spindle and 0.43% of acid.

No. 1284. *Robin noir*, from Cupertino. A sample for must analysis was received October 3, 1890, in good condition. The must showed 21.5% of solid contents by spindle and 0.81% of acid.

No. 1428. *Robin noir*, from Mission San José. A sample for must analysis was received October 30, 1890, in fair condition and mature. The must showed 24.45% of solid contents by spindle and 1.05% of acid.

No. 1694. *Robin noir*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 24.8% of solid contents by spindle and 0.34% of acid.

No. 1792. *Robin noir*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 22.5% of solid contents by spindle and 0.91% of acid. The grapes were crushed and fermented with No. 1791, Carignane, from Mission San José.

No. 1807. *Robin noir*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition. The bunches were well filled, the berries small, hard, and tasteless. The must showed 21.75% of solid contents by spindle and 0.93% of acid.

No. 1953 *Robin noir*, from Paso Robles station. Received October 15, 1893, in fair condition. The bunches were of over medium size, irregularly conical, very compact, the lower ends turned to one side; the berries were of medium size, round, thick-skinned, juicy, fresh-tasting, but with little flavor, mature. The must showed 23.7% of solid contents by spindle and 0.58% of acid. The 107 lbs. crushed were started at a temperature of 64°, and reached a maximum of 85° on the third day. The wine was dry on the fourth day, and was drawn off on the fifth.

At one month the wine was nearly clear, very astringent, with little color and good flavor. At three months it was racked for the second time; it was clear, and showed good quality, but still retained a slight sweetness, and was not quite clean-tasting. It remained sub-sweet for some time, but finally became dry, and at ten months was of fair quality; it was racked for the third time, and part put in bottle. At sixteen months it was in good order, dry, with little color, somewhat "éventé." Three weeks later it was bottled.

No. 1971. *Robin noir*, from Tulare station. A sample for must analysis was received October 16, 1893, in good condition. The bunches were very small, conical, compact; the berries small, nearly round, very thick-skinned, soft, juicy, with full acid, but little color. The grapes had the appearance of second crop. The must showed 24.45% of solid contents by spindle and 0.45% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF BURGUNDY TYPE (RED).

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Pinots.										
1219	Fresno	1890	21.50	21.38	.69	.39					
1224	Fresno	1890	25.00	25.19	.62	.55					
1232	Fresno	1890	25.40	24.64	.42	.38					
1258	Mission San José	1890	24.80		.65	.31					
1506	Mission San José	1891	25.00	24.64	.61						
1508	Mission San José	1891	25.00	24.64	.53	.39					
1588	Mission San José	1891	28.00	28.32	.54						
1638	Mission San José	1892	22.70		.75		11.45	.189	.64	.63	2.70
2064	Mission San José	1893	28.60	27.65	.47			.262			
2077	Mission San José	1893	28.30	26.99	.48		13.27	.150	.61	.50	3.20
2263	Mission San José	1894	22.20		.74			.173			
1325	Cupertino	1890	26.30		.54						
1332	Cupertino	1890	25.75		.81						
1374	Cupertino	1890	27.80		.57						
1392	Cupertino	1890	29.70		.34						
1437	Tulare	1891	23.60		.29						
1624	Tulare	1892	22.15		.37						
2005	Tulare	1893	23.10	21.80	.32						
1484	Paso Robles	1891	19.70		.54						
1744	Paso Robles	1892	21.10		.34						
1910	Paso Robles	1893	23.50	23.71	.41		10.00	.138	.44	.35	2.40
1809	Amador station	1893	23.30		.56			.230	.53		
1819	Amador station	1893	22.80	22.33	.53		11.27	.189	.49	.86	3.30
	Average, Fresno		**23.97**	**23.74**	**.58**	**.44**					
	Average, Mission San Jose		**25.57**	**26.45**	**.59**	**.35**					
	Average, Cupertino		**21.91**		**.45**						
	Average, Tulare		**22.95**	**21.80**	**.36**						
	Average, Paso Robles		**21.43**	**23.71**	**.43**		**10.00**	**.138**	**.44**	**.35**	**2.40**
	Average, Amador station		**23.05**	**22.33**	**.55**		**11.27**	**.109**	**.51**	**.86**	**3.30**

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing.	At 6 to 8 Months	
	Pinot de Pernand.										
1226	Fresno	1890	24.55	24.22	.54	.46					
1367	Cupertino	1890	25.90		.75						
1480	Paso Robles	1891	21.30	17.70	.48						
1867	Paso Robles	1893	22.60	20.61	.47	.31		.102			
1504	Mission San José	1891	24.55	23.62	.53	.32					
2270	Mission San José	1894	25.20		.46			.175			
1702	Tulare	1892	26.90		.39						
1799	Tulare	1893	23.30		.67						
2152	Tulare	1894	22.60		.57						
	Average, Paso Robles		**21.95**	**19.16**	**.48**	**.31**		**.102**			
	Average, Mission San Jose		**24.88**	**23.62**	**.49**	**.32**		**.175**			
	Average, Tulare		**24.27**		**.54**						
	Meunier.										
1212	Fresno	1890	24.10	23.61	.41	.20					
1259	Mission San José	1890	24.60		.57	.39					
1507	Mission San José	1891	25.85	25.76	.52						
2078	Mission San José	1893	28.00		.45			.329			
2267	Mission San José	1894	28.00		.45						
1280	Cupertino	1890	24.55		.53	.53					
2057	Cupertino	1893	26.70		.69			.304			
1558	Paso Robles	1891	22.15		.66						
1746	Paso Robles	1892	23.50		.39						
1691	Tulare	1892	22.40		.30						
2309	Tulare	1894	23.70		.38						
1808	Amador station	1893	23.70		.51						
	Average, Mission San Jose		**26.61**	**25.76**	**.49**	**.39**		**.329**			
	Average, Cupertino		**25.62**		**.61**	**.53**		**.304**			
	Average, Paso Robles		**22.83**		**.53**						
	Average, Tulare		**23.05**		**.34**						

	Robin noir.										
1230	Fresno	1890	27.45	28.33	.43	.22					
1284	Cupertino	1890	21.50		.81						
1428	Mission San José	1890	24.45		1.05						
1792	Mission San José	1892	22.50		.91						
2301	Mission San José	1894	22.10		.71						
1694	Tulare	1892	24.80		.34						
1971	Tulare	1893	24.45	24.64	.45	.51					
2336	Tulare	1894	27.80		.34						
1807	Amador station	1893	21.75		.93						
2199	Amador station	1894	28.40		.48						
1953	Paso Robles	1893	23.70	22.23	.58	.30	12.09	.147	.60	.41	2.60
	Average, Mission San Jose		**23.02**		.89						
	Average, Tulare		**25.68**	**24.64**	.38						
	Average, Amador station		**25.08**		.70						

JURA TYPE.

There is a class of full-bodied, deep-colored wines, of good and even high character, which are produced at various places in the region of the Rhone from the slopes of the Jura Mountains to the vineyards of the Hermitage. These wines differ markedly from the delicate Burgundies to the north, and equally from the neutral and rancio red wines to the south. They resemble to some extent the Medocs, but are heavier than the Clarets of commerce. They may be considered as holding an intermediate position between the Medoc wines and those of northern Italy. Wines made from Petite Sirah, Mondeuse, and César are of this type, and reach their highest development in the first growth of the Hermitage, made principally from Petite Sirah. The Beclan makes a wine of smoother and more neutral character, which is used to modify the occasionally excessive asperity of the above grapes. Though grown in connection with the grapes of this type, it has been placed among the Southern French, on account of the different character of its wine.

The *Petite Sirah* and *Mondeuse* are the varieties included in this type which have shown the highest quality in California. The former has been largely abandoned, on account of its poor bearing qualities; but the Mondeuse is deserving of a much more extended place in our vineyards than it has at present. It is a remarkably regular and fairly abundant bearer; it unites quality and abundance in as high a degree as perhaps any other red grape yet tried. It is especially adapted to the coast counties wherever the ripening is not too late.

One of the most valuable grapes of this category, though not properly belonging to the group, is the *Tinta Valdepeñas*. A really excellent wine has been made from it at Tulare; a somewhat surprising result, considering the climate and the nature of the soil where it was grown. For rich valley soils in the hotter districts probably no better choice could be made with the object of producing dry red wines. Some of the Italian varieties approach it in adaptability to these conditions, but none so far tried surpass it in the quality of their products.

SIRAH.

(See Vit. Rept. 1883–85, p. 101; 1885–86, p. 83; 1887–89, p. 177.)

But for its liability to coulure in certain localities, there would doubtless have been a much more extended planting of Petite Sirah than there has been. At Mission San José and in parts of Napa and Sonoma it has given excellent results. From Oakville and Mission San José it is reported as producing four tons per acre with short-pruning. In the Livermore Valley and in parts of Napa, it has been much less satisfactory, and no system of pruning seems to be capable of combating its tendency to drop its fruit. The remedy seems to be, as pointed out in the last report, to choose cuttings from fruitful vines only, as there seem to be forms or variations of the variety more subject to coulure than others. The form cultivated at the stations under the name of Serine sets its fruit and bears much better than the form cultivated under the name of Sirah.

At Tulare the vine has shown itself a good grower, with plenty of foliage, and bears from three to four tons per acre with long-pruning.

The wine produced there has some character, fair color, good body, and medium acid and astringency; it is not adapted to use alone, as it does not keep very well and drops its color. It is useful, however, to blend with an acid wine of less character and color.

The grapes received from Paso Robles in good condition have had an average composition of 24.4% of sugar and 0.55% of acid, and have given a wine of fair quality, good body and astringency, and good, stable color. At Amador station the vine grows fairly well and bears about two and a half tons per acre, but goes a good deal to second crop, and gives a must low in acid. The average composition of the must has been at Cupertino 26.2% of sugar and 0.52% of acid, and at Mission San José, where it has been most successful, 25.2% of sugar and 0.72% of acid. At the latter place it has made uniformly an excellent wine of full body and astringency, of good acid and quality; it is also an excellent keeper.

ANALYSES OF MUSTS AND WINES.

SIRAH.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1242.	Fresno	Aug. 1	25.10	24.11	.43	.37	9.92	12.36	.244	.30	.48	2.70
No. 1278.	Cupertino	Oct. 1	24.15	......	.67	......	......	......	......	......	......	......
No. 1296.	Mission San José	Oct. 1	25.30	......	.54	.22	9.99	12.46	.259	.71	.45	3.45
No. 1341.	Mission San José	Oct. 11	25.40	......	.64	.19	10 54	13.00	.301	.44	.38	3.32
No. 1370.	Cupertino	Oct. 14	24.15	......	.52	......	......	......	......	......	......	......
1891—No. 1438.	Tulare	Aug. 24	25.65	......	.37	......	......	......	......	......	......	......
No. 1472.	Fresno	Aug. 28	25.20	......	.48	......	9.92	12.36	.240	.51	.43	3.35
No. 1488	Paso Robles	Sept. 12	23.70	......	.50	......	......	......	......	......	......	......
No. 1492.	Paso Robles	Sept. 13	24.80	......	.53	......	......	......	......	......	......	......
No. 1564.	Mission San José	Oct. 6	27.35	......	.65	......	12.39	15.20	.411	.71	.43	3.20
1892—No. 1616.	Tulare	Aug. 26	23.70	22.23	.43	.30	8.48	10.58	.192	.32	.46	3.90
No. 1635.	Tulare	Sept. 4	25.10	......	.41	......	......	......	......	......	......	......
No. 1647.	Paso Robles	Sept. 13	23.95	......	.69	......	......	......	......	......	......	......
No. 1664.	Amador station	Sept. 16	26.40	......	.42	......	......	......	......	......	......	......
No. 1708.	Mission San José	Oct. 3	23.25	23.13	.78	.35	9.27	11.55	.335	.83	.70	2.95
1893—No. 1814.	Tulare	Sept. 1	22.40	21.80	.62	.50	8.27	10.36	.141	.47	.51	3.20
No. 1879.	Paso Robles	Sept. 15	22.60	20.99	.53	.43	......	......	.237	.46	......	......
No. 1895.	Paso Robles	Sept. 28	25.85	25.53	.51	.37	9.92	12.36	.211	.51	.50	3.30
No. 1952.	Mission San José	Oct. 14	24.60	......	.94	......	......	......	.345	.77	......	......
No. 2044.	Cupertino	Nov. 1	28.60	......	.58	......	......	......	.502	......	......	......
No. 2052.	Cupertino	Oct. 31	28.20	......	.58	......	......	......	.553	.79	......	......
No. 2076.	Mission San José	Nov. 3	28.80	25.65	.63	.30	10.91	13.36	.256	.65	.67	3.30
1894—No. 2139.	Tulare	Sept. 10	21.50	20.83	.65	......	8.84	11.00	.159	.58	.44	2.85
No. 2153.	Tulare	Sept. 17	24.00	......	.53	......	......	......	......	......	......	......
No. 2254.	Mission San José	Oct. 5	23.70	......	.64	......	......	......	.236	......	......	......
No. 2269.	Mission San José	Oct. 5	23.70	......	.68	......	......	......	.245	......	......	......
No. 2286.	Amador station	Oct. 6	23.50	......	.48	......	......	......	......	......	......	......

COLOR READINGS.

SIRAH.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1890—No. 1341.	Mission San José														
1891—No. 1472.	Fresno	47.0	2VR	25.0	5VR	14.9	2VR+Y	15.2	1VR+Y	15.2	4VR+Y	13.8	1VR+Y		
No. 1564.	Mission San José	149.0	VR	81.6	1VR	97.6	1-2VR	61.0	1-2VR	66.6	2VR				
1892—No. 1616.	Tulare	16.0	R	11.4	1R	10.5	2R	10.7	3R	12.5	3R	11.4	3R	11.1	3R
No. 1708.	Mission San José	285.0	VR	166.0	VR	103.0	2VR	80.0	2VR	74.2	2VR	70.2	2VR		
1893—No. 1814.	Tulare	14.1	1VR+Y	8.5	2VR+Y	5.5	(Y)								
No. 1879.	Paso Robles	66.6	VR	41.6	VR										
No. 1895.	Paso Robles	70.2	VR	40.0	2VR	26.4	2VR	25.2	2VR	21.7	3VR	21.6	4VR		
No. 1952.	Mission San José	143.0	VR												
No. 2044.	Cupertino	114.0	VR												
No. 2052.	Cupertino	103.0	1VR												
No. 2076.	Mission San José	129.0	VR-1VR	103.0	1VR	90.9	2VR	85.1	2VR	40.8	3VR				
1894—No. 2139.	Tulare	30.0	2VR	7.1	1R										
No. 2254.	Mission San José	88.8	VR												
No. 2269.	Mission San José	85.1	VR												

RECORD OF TREATMENT.

No. 1242. *Petite Sirah*, from Margherita Vineyard, Fresno. Received August 2, 1890, in fairly good condition. Berries somewhat small for the variety, maturity complete. The must showed 25.1% of solid contents by spindle. The temperature of the must at crushing was 67°, and the maximum reached was 91°, on the third day. The murk was still a little sweet on the fifth day, when it was drawn off.

The wine continued to ferment slowly, and remained cloudy for over six weeks after pressing. At nine weeks it was clear, without bouquet, with little flavor, full tannin, and medium acid. At this date it was pasteurized, as the lees showed some lactic germs, though the taste was as yet unaffected. At eight months the wine had been racked three times, and was bright, improved in flavor, had developed a little bouquet, but was still harsh. It continued to improve up to the age of about fourteen months, at which date it was nearly mature and quite sound. It was bottled at nineteen and twenty-four months. At a little over three years both wines were tasted, and that first bottled was found to be the better. Both wines were of fair quality, of good flavor and body, but without bouquet and not quite clean-tasting.

No. 1278. *Petite Sirah*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 2, 1890, in good condition. The bunches were loose and with many small berries. The must showed 24.15% of solid contents by spindle.

No. 1296. *Petite Sirah*, from Mission San José. Received October 3, 1890, in good condition. The berries were rather small and many of them abortive. The must showed 25.3% of solid contents by spindle. The temperature of the must was 68° at crushing, and the highest temperature reached was 89°, on the third day. The murk was nearly dry on the fourth day, and was drawn off on the fifth.

The wine was nearly clear within three weeks from pressing. At two months it was quite clear, with full and pleasing flavor, good acid and astringency, but aroma somewhat masked by a slight moldiness. At three months the lees showed a few lactic ferments, and the wine was pasteurized. At seven months it was bright and much improved, full flavored, and of good quality. It kept remarkably well, considering the small size of the sample, and at fourteen months was a wine of high quality, in excellent condition, and with good bouquet and rich flavor. At sixteen months it was bottled.

No. 1341. *Serine*, from Mission San José. Received October 14, 1890, in bad condition, many of the bunches moldy. The must showed 25.4% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the maximum reached was 92°, on the fourth day. The murk was nearly dry on the fifth day, and was drawn off on the sixth.

In three weeks the wine was clear, still a little sweet, and highly astringent. At three months it was bright, full flavored, with good body, high astringency and alcohol, medium acid, and in general a good wine. The lees showed a few lactic ferments, and the wine was pasteurized, though the taste was still unaffected. The wine remained a little flat for some time, but gradually improved up to the time it was bottled, at sixteen months. At three years the bottled wine was bright, highly flavored, full-bodied, and generally of high quality, but not quite clean-tasting.

No. 1370. *Serine*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 17, 1890, in good condition, but overripe. The must showed 24.15% of solid contents by spindle.

No. 1438. *Serine*, from Tulare. A sample for must analysis was received August 27, 1891, in good condition. The must showed 25.65% of solid contents by spindle.

No. 1472. *Serine*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition. The must showed 25.2% of solid contents by spindle. The temperature of the must at crushing was 68°, and the maximum reached was 83°, on the third day. The murk was nearly dry on the seventh day, when it was drawn off.

The wine remained slightly sweet for two or three weeks after pressing, but at five weeks was clear and dry. At six weeks it was clear, full-bodied and well flavored, but with a suspicious taste. The lees showed a few lactic ferments, and the wine was pasteurized. At four months it had improved, had developed some bouquet, but still tasted a little flat. It was racked four times during the first year, and successive tastings showed a gradual improvement up to the time it was bottled at sixteen months, when it was bright, with some bouquet and flavor, sound and clean-tasting. At three years and a half the wine was bright, of fair color, good bouquet and flavor; a very agreeable wine of more character than the Mourastel, but not quite so clean-tasting.

No. 1492. *Petite Sirah*, from Paso Robles station. A sample for must analysis was received September 16, 1891, in good condition, small, and mature. The must showed 24.8% of solid contents by spindle.

No. 1564. *Serine*, from Mission San José. Received October 9, 1891, in fair condition. The must showed 27.35% of solid contents by spindle. The temperature of the must at crushing was 60° and the maximum reached was 87°, on the fourth day. The murk was nearly dry on the sixth day, and was drawn off on the seventh.

At six weeks the wine was clear, with some aroma and full flavor, medium acid, and high astringency. At four months it was bright and of very good quality, showing no defect but a slight bitterness. At five months the wine was full-bodied and very good, with a slight sub-sweetness, but quite sound. It was racked three times during the first year, and remained in good order and developed well up to the time it was bottled at sixteen months.

No. 1616. *Serine*, from Tulare station. Received August 29, 1892, in good condition, and mature; there were a few small, abortive, green berries. The must showed 23.7% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the maximum reached was 96°, on the sixth day. The murk was not dry till the eighth day, when it was pressed.

This sample was fermented with No. 1617, Mondeuse, from Tulare, in the proportion of 72% of Serine to 28% of Mondeuse. In one month from pressing, the wine was clear, sound, and dry, but tasted a little flat. At four months it was bright, had good flavor, but the odor was not good, and the after-taste slightly bitter. The lees showed some filaments, so the wine was pasteurized. Two months after this the wine was racked; it had improved a little, but was not quite clean-tasting; its color was fairly good for a Tulare wine. It was bottled at nineteen months.

No. 1635. *Petite Sirah*, from Tulare station. A sample for must analysis was received September 6, 1892, in good condition. The must showed 25.1% of solid contents by spindle.

No. 1647. *Serine*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 23.95% of solid contents by spindle.

No. 1664. *Serine*, from Amador foothill station. A sample for must analysis was received September 19, 1892, in poor condition. The must showed 26.4% of solid contents by spindle.

No. 1708. *Serine*, from Mission San José. Received October 5, 1892, in fair condition. The must showed 23.25% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum reached was 91°, on the third day. The murk was dry on the fourth day, and was drawn off on the fifth.

In three weeks the wine was clear and of good promise. At three months it was bright, of full, rich flavor, smooth, and of high quality. At five months it had improved, its acid and astringency being very marked. At this date it was racked for the second time. It remained bright and in good order, retaining its good quality till it was bottled at eighteen months.

No. 1814. *Serine*, from Tulare station. Received September 1, 1893, in fair condition, a few grapes moldy. The bunches were compact, the berries small and without flavor. The must showed 22.4% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the maximum reached was 92°, on the fifth day. The murk was dry on the fifth day, when it was drawn off.

In three weeks the wine was clear, and was racked and taken to the cellar. At five months it was clear and sound, but flat and of poor quality. At this date it was racked for the second time. At seven months it had improved somewhat, but was not fresh-tasting.

No. 1879. *Petite Sirah*, from Paso Robles station. Received September 15, 1893, in good condition. The bunches were loose and small, the berries small and well flavored, and mature. The must showed 22.6% of solid contents by spindle. The sample was used for must analysis and for color and tannin tests.

No. 1895. *Serine*, from Paso Robles station. Received September 28, 1893, somewhat crushed, but otherwise in good condition. The bunches were of good size, not compact; the berries of good size, well colored, and mature. The must showed 25.85% of solid contents by spindle. The temperature of the must was 66° at crushing; the maximum temperature reached was 87°, on the fourth day. The murk was dry on the sixth day, when it was drawn off.

The wine was somewhat slow in clearing, and was at first excessively rough. At two months it was nearly clear, highly flavored, and of full body. At four months it was clear, agreeably flavored, and smoother, but with a slightly bitter after-taste. At five months it was racked for the second time. At eight months it had improved, but was not quite clean-tasting.

No. 1952. *Petite Sirah*, from Mission San José. Received October 14, 1893, in poor condition, having been too long on the road. The bunches were of good size, irregular, well filled, but not compact. The grapes were well flavored, and the must showed 24.6% of solid contents by spindle. The sample was used for must analysis and for color and tannin tests.

No. 2044. *Petite Sirah*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were under medium size, conico-cylindrical, loose, much coulured; the berries were small, oval, much shriveled, overripe. The must showed 28.6% of solid contents by spindle.

No. 2052. *Serine*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were of medium size, long, conico-cylindrical, loose, but little coulured; the berries were small, commencing to shrivel, but with good acid. The must showed 28.2% of solid contents by spindle.

No. 2076. *Serine*, from Mission San José. Received November 3, 1893, in good condition. The bunches were under medium size, long, conico-cylindrical, with or without a small wing, loose; the berries were small, firm, but not crisp or pulpy, oval, very sweet, overripe. The must showed 28.8% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the maximum temperature reached was 87°, on the third day. The murk was still sweet on the sixth day, when it was drawn off.

In one month from crushing the wine was clear and dry. In two months it was bright, full-bodied, with dense color, full astringency, medium acid, and good flavor. At six months it was in excellent condition, still rough, but sound and with solid keeping qualities.

MONDEUSE.

(See Vit. Rept. 1883–85, p. 102; 1885–86, p. 83; 1887–89, p. 186.)

The latest experiments with the Mondeuse have confirmed the opinions expressed in former reports, and also the reputation the variety has in Europe, viz., that in suitable localities it will produce good crops, making full-bodied wines of good color, character, and keeping qualities, but in other localities its wine is thin and not of high quality. At the Mission San José station the vines have borne well, but the wine has been somewhat unsatisfactory, lacking in body and vinosity, though of good flavor. In the vineyard of Mr. McIver, of Mission San José, it has done better, but its best qualities are brought out in Napa and Sonoma, where it produces a wine of good body, color, and excellent keeping qualities. In Napa it is said to produce four to five tons to the acre with short-pruning; it also bears well in the Santa Clara Valley with short-pruning, but is occasionally subject to coulure.

At Tulare the vine is not a very strong grower, and though it sometimes bears good crops it is liable to coulure. The must is rather low in acid (average 22% of sugar and 0.42% of acid), but makes a good wine as regards tannin, color, and character. It makes a red wine of more vinosity and quality than perhaps any other grape at Tulare, but somewhat lacking in body. At the Amador station it has not borne well and has been subject to coulure. At Paso Robles it has succeeded better; but it has not yet been sufficiently tested there.

ANALYSES OF MUSTS AND WINES.

	MONDEUSE.	Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1312.	Cupertino	Oct. 6	20.40	------	.79	.21	7.78	9.73	.237	------	.45	2.70
No. 1334.	Mission San José	Oct. 11	21.70	------	.76	.21	8.84	11.00	.294	.58	.50	2.58
1891—No. 1563.	Mission San José	Oct. 6	22.15	------	.68	------	8.91	11.09	.259	.77	.53	2.30
No. 1582.	Mission San José	Oct. 13	22.60	22.22	.53	------	9.20	11.45	.272	.68	.43	2.70
No. 1595.	Kenwood, Sonoma County	Oct. 16	23.70	22.22	.43	.33	9.78	12.18	.375	.58	.50	3.35
1892—No. 1617.	Tulare	Aug. 26	22.30	21.80	------	.35	------	------	------	------	------	------
No. 1729.	Paso Robles	Oct. 1	22.05	------	.47	------	------	------	------	------	------	------
No. 1764.	Mission San José	Oct. 12	19.75	19.54	.72	------	7.78	9.73	.256	.84	.74	2.60
1893—No. 1888.	Tulare	Sept. 22	20.20	19.08	.45	.31	7.78	9.73	.256	.53	.46	2.30
No. 1922.	Paso Robles	Oct. 12	22.60	21.38	.45	.30	8.20	10.25	195	.53	.70	3.30
No. 2037.	Cupertino	Nov. 1	23.10	------	.69	------	------	------	.432	.98	------	------
No. 2062.	Mission San José	Nov. 1	22.60	21.40	.65	.21	8.27	10.36	.301	.74	.62	2.60
1894—No 2174.	Amador station	Sept. 24	21.50	------	.56	------	------	------	------	------	------	------
No. 2206.	Tulare	Sept. 27	23.60	------	.47	------	------	------	------	------	------	------
No. 2216.	Paso Robles	Sept. 28	22.30	------	.53	------	------	------	------	------	------	------
No. 2264.	Mission San José	Oct. 5	20.50	------	.57	------	------	------	.203	------	------	------

COLOR READINGS.

	MONDEUSE.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1891—No. 1563.	Mission San José	------		65.5	1VR	42.5	2VR	26.8	3VR	27.0	4VR	------		------	
No. 1582.	Mission San José	90.9	1VR	52.0	1VR	42.5	1VR	37.3	1VR	27.7	4VR	------		------	
No. 1595.	Kenwood, Sonoma County	88.8	1VR	66.6	2VR	45.9	3VR	47.6	4VR	38.0	5VR	------		------	
1892—No. 1764.	Mission San José	111.0	2VR	103.0	2VR	38.8	2VR	33.9	1VR	29.2	1VR	32.0	1VR	16.0	3VR
1893—No. 1888.	Tulare	28.4	1VR	30.8	1VR	17.4	2VR	14.0	3VR	14.0	4VR	13.1	5VR	------	
No. 1922.	Paso Robles	121.0	VR	38.0	1VR	37.4	1VR	38.0	2VR	27.2	3VR	29.4	3VR	------	
No. 2037.	Cupertino	50.6	1-2VR	------		------		------		------		------		------	
No. 2062.	Mission San José	93.0	VR-1VR	48.2	1VR	50.0	1-2VR	50.0	1-2VR	------		------		------	
1894—No. 2264.	Mission San José	76.9	VR												

Record of Treatment.

No. 1312. *Mondeuse*, from J. T. Doyle, Cupertino. Received October 10, 1890, in good condition, and mature. The must showed 20.4% of solid contents by spindle. The temperature of the grapes at crushing was 62°, and the maximum reached was 79°, on the fifth day. The murk was drawn off on the sixth day, when it was nearly dry.

At one month the wine was clear and showed high acid and astringency. At two months it was racked, and at three it had a light bouquet, good flavor, clean taste; was rough but promising. The lees showed some unsound ferments, so the wine was pasteurized. At seven months the wine was bright, improved in bouquet and flavor, smoother, and maturing well. At fifteen months it was in good condition, very fresh and clean-tasting, and nearly mature. It was bottled, part at seventeen and part at twenty-three months. At three years the wine first bottled was bright, very pleasant, smooth, and clean-tasting. The second bottling had not kept well.

No. 1334. *Mondeuse*, from Mission San José. Received October 14, 1890, in good condition, and mature. The must showed 21.7% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum reached was 92°, on the fourth day. On the fifth day the murk was nearly dry, and on the sixth was drawn off.

In three weeks the wine was clear, but very raw-tasting. At six weeks it showed marked flavor and aroma, clean taste, full acid and tannin, and, in general, good quality. In three months it had progressed well, its bouquet and flavor were good, and it tasted quite sound, though the lees showed a few filaments. It was pasteurized for safety. Two months after pasteurizing it was in good condition, showed good acid and body, and was aging well. At nine months it was racked for the third time. At fifteen months it was very bright, had excellent color, and was generally good but for a slight odor of butyric acid. It was bottled at twenty-six months. At three years the wine in bottle was bright, smooth, and agreeable, but not quite clean-tasting.

No. 1563. *Mondeuse*, from Mission San José. Received October 9, 1891, in good condition, and mature; some of the grapes were shriveled. The must showed 22.15% of solid contents by spindle. The temperature of the must at crushing was 60°, and the maximum reached was 85°, on the fourth day. The murk was dry on the fifth day, when it was drawn off.

At five weeks the wine was bright, full-flavored, and showed high acid and astringency. It remained bright, was racked twice during the first ten months, developed some bouquet, but was somewhat harsh. The lees showed a good deal of *S. pastorianus*. The wine continued sound, and improved much in aging. It was bottled, part at sixteen and part at twenty-one months. At three years the wine bottled at ten months was bright, of good color, bouquet, and flavor, but a little raw; at sixteen months it was better, clean-tasting, and of high flavor; at twenty months not quite so good as at sixteen months. The wine was rather thin and lacking in body.

No. 1582. *Mondeuse*, from Mission San José. Received October 16, 1891, in fair condition. The must showed 22.6% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum attained was 85°, on the third day. The murk was dry on the fourth day, when it was drawn off.

In one month the wine was clear, with full and pleasing flavor, some aroma, good astringency and acid. At two months it was bright and in good order. It remained bright, and the lees developed much *S. pastorianus*. At eight months the wine was bright, very smooth, and pleasing, with high bouquet, and maturing quickly. It was racked for the second time at ten months. At fifteen months it was in excellent order, and nearly mature. A month later it was bottled. At three years the bottled wine was bright and of good bouquet and flavor, but a little lacking in color and body. Blended with No. 1582, a full-bodied, heavy-colored Alicante Bouschet, it was much improved.

No. 1595. *Mondeuse*, from A. Macartney, Los Guilicos, Sonoma County. Received October 19, 1891, in good condition, but a little past maturity. The must showed 23.7% of solid contents by spindle. The temperature of the grapes at crushing was 64°, and the maximum reached was 82°, on the third day. The murk was drawn off on the fourth day while still sweet. It was dry on the eighth day.

In one month the wine was clear, possessed of good flavor and some aroma; it was very rough, with high astringency. It was racked at two months, and at five was bright, a full-bodied, well-rounded wine in excellent order. It was racked again at eight months, and remained bright, maintaining its high quality. At fifteen months it was in first-class condition, with excellent bouquet and flavor, and had kept perfectly in spite of the smallness of the sample (two gallons). At this date it was bottled. At three years the bottled wine was bright, with good color and bouquet, excellent flavor, and clean taste; an extremely good wine of high body, full but pleasing acid and astringency, and high vinosity.

No. 1617. *Mondeuse*, from Tulare station. Received August 29, 1892, in good condition, and mature. The must showed 22.3% of solid contents by spindle. This sample was fermented with No. 1616, Serine, from Tulare.

No. 1729. *Mondeuse*, from Paso Robles station. A sample for must analysis was received October 3, 1892, in good condition. The must showed 22.05% of solid contents by spindle.

No. 1764. *Mondeuse*, from Mission San José. Received October 15, 1892, in good condition. The must showed 19.75% of solid contents by spindle. The temperature of the grapes at crushing was 58°, and the maximum reached was 85°, on the fourth day. The murk was still a little sweet on the fifth day, and was drawn off on the sixth.

The wine was not very prompt in clearing, but was nearly clear at one month, when it was racked. At three months it was bright, with high acid and astringency, raw but promising. It remained harsh and green for some time, but continued sound, and developed some bouquet. At fourteen months it had somewhat softened down and possessed a light and delicate bouquet; it was, however, still a little harsh and not quite mature. It was bottled at eighteen months.

No. 1888. *Mondeuse*, from Tulare station. Received September 22, 1893, in good condition. The bunches were large and well filled; the berries were of medium size, juicy, soft, mature, the skin very astringent. The must showed 20.2% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the highest temperature reached was 83°, on the second day. The murk was still a little sweet on the fourth day, and was drawn off on the fifth.

In three weeks it was clear, and was then racked and taken to the cellar. In four months it was bright, well flavored, with some bouquet, high astringency, adequate acid—a clean-tasting, good wine, one of the best of the Tulare red wines. At six months it had been racked twice, and remained bright, sound, fresh, and agreeable.

No. 1922. *Mondeuse*, from Paso Robles station. Received October 12, 1893, in good condition. The bunches were irregular, loose, rather small; the berries small. The grapes were mature and some of them dried. The must showed 22.6% of solid contents by spindle. The temperature of the grapes at crushing was 69°. The fermentation lasted five days, and was cool, owing to the small size of the sample.

In three weeks the wine was clear, of good flavor, with moderate acid and pleasing astringency. It soon became bright, and at seven months was an agreeable wine, in excellent condition, but a little green.

No. 2037. *Mondeuse*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were over medium in size, long conical, close, with small wings; the berries were of medium size, somewhat shriveled, but fresh-tasting and with abundant acid. The must showed 23.1% of solid contents by spindle.

No. 2062. *Mondeuse*, from Mission San José. Received November 1, 1893, in good condition. The bunches were of medium size, conical, shouldered or with small wings, loose but well filled; the berries were of medium size, very slightly oval, juicy, well flavored, and the skin very astringent. The must showed 22.6% of solid contents by spindle. The temperature of the grapes at crushing was 62°, and the maximum reached was 85°, on the fourth day. The murk was dry on the fifth day, and was drawn off on the sixth.

In three weeks the wine was nearly clear, and was racked and taken to the cellar. At three months it was bright, well flavored, clean-tasting, with good acid and astringency—an excellent wine but for a slight moldy color. At six months it had been racked twice, and was in good condition and showed improvement.

CÉSAR.

Synonyms: Romain; Picarniau.

Description.—Vine vigorous and productive; canes strong, semi-erect, with long joints; leaves of medium size, wrinkled, glabrous above, tomentose below, five-lobed, with open sinuses; bunches over average size, close, conico-cylindrical, with strong peduncles; berries of medium size, round, with thick skin, and firm but juicy flesh.

The César is rather widely cultivated in the Auxerrois, where it is considered the most valuable variety next to the Pinots. In character it is much more nearly allied to the Mondeuse and Sirah than to the Pinots, and is therefore put in this group. Its wine is not of such high quality as that of the Franc Pinot, but is much esteemed, and when grown on hillsides is of good body and color. On low or very rich soils the vine runs too much to wood, and coulures. This tendency can be combated to some extent by training on trellis with long arms and short-pruning. On hillsides it bears well with ordinary short-pruning. This variety has been tested to such a limited extent in California that little can be said as to its adaptability. Its wine is of very different character from that of the Pinots, being highly astringent and deeply colored. The only sample made at the station did not keep very well, but that is to be accounted for by the overripe and crushed condition of the grapes when they arrived.

Analysis of No. 1594, César, from Kenwood.

Must—	
Solid contents by spindle	26.50%
Sugar by copper test	26.31
Acid as tartaric	.50
Ash	.37
Wine—	
Alcohol by volume	13.54
Acid at pressing	.50
Acid at six months	.40
Tannin	.544
Body	3.35

Color Readings.

At pressing	222.0	VR
At one month	88.8	1VR
At two months	72.0	1VR
At three months	68.0	2VR
At four months	51.2	2VR

Record of Treatment.

No. 1594. *César*, from A. Macartney, Kenwood, Sonoma County. Received October 19, 1891, in fair condition, a little crushed and moldy, somewhat past maturity, many of the grapes being dried up. The bunches were over average in size, conico-cylindrical, sparingly winged, not compact, but well filled with round, well-colored and medium-sized berries. The must showed 26.5% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 64°, and the maximum reached was 97°, on the fourth day. The wine was drawn off on the fifth day, while still sweet and fermenting. On the eighth day it was dry.

At one month the wine was not quite clear, was full-bodied and of high astringency, and with still a suspicion of sugar. At two months it was bright, with little bouquet, full flavor, and very good but for a taste of dried grapes. The wine was racked, and two months later it showed signs of some secondary fermentation. At one year the wine was good, except for some bitterness caused by secondary fermentation. At twenty-two months it was bottled. Eighteen months after bottling the wine was clear, of deep color, heavy body, a very full, rich wine, but injured by secondary fermentation.

ETRAIRE DE L'ADHUI.

This grape is considered by some authorities as a distinct variety from the Persan, and by others as simply an improved variation obtained by selection. It is extensively cultivated in the valley of L'Isère, where it is said to be vigorous, hardy, and fertile. It is especially suited to hills, and requires short-pruning. The wine is noted for its good body and excellent keeping qualities. It is generally fermented with one tenth of some white grape to improve its delicacy and vinosity. One of the most valued attributes of this variety is its almost perfect resistance to the mildew (*Peronospora*). So far, this variety has not sustained its European reputation as a prolific bearer at any of the stations. The analyses of the musts, however, indicate that its characteristic robustness is not lost here. It is noticeable for the full amount of acid which it maintains with high sugar; No. 1395, from Cupertino, with 29% of sugar and 1.15% of acid, is remarkable. The wine has sufficient color, nearly equal to that of the Mondeuse. The wines of these two varieties are said to be very similar in France; here the indications are that the Etraire would make a somewhat heavier wine than the Mondeuse.

Analyses of Musts and Wines.

ETRAIRE DE L'ADHUI.	Date of Picking	MUST.				WINE.	
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Tannin	Total Acid as Tartaric, at Pressing
1890—No. 1395. Cupertino	Oct. 17	29.10	......	1.15	......	......	......
1893—No. 2118. Cupertino	Nov. 1	25.70	......	.77	......	.352	.62
1894—No. 2296. Mission San José	Oct. 12	23.50	......	.75	......	.153	.75

Color Readings.

ETRAIRE DE L'ADHUI.	At Pressing.	
1893—No. 2118. Cupertino	62.5	1VR
1894—No. 2296. Mission San José	59.7	2-3VR

Record of Treatment.

No. 1395. *Etraire de l'Adhui*, from Cupertino. A sample for must analysis received October 21, 1890, in fair condition, but overripe. The must showed 29.1% of solid contents by spindle and 1.15% of acid.

No. 2118. *Etraire de l'Adhui*, from Cupertino. A sample for must analysis was received November 1, 1893, in good condition, and mature. The bunches were of medium size, irregularly cylindrical, with small wings, well filled below, loose above; the berries were small, slightly elongated, soft, and juicy. The must showed 25.7% of solid contents by spindle and 0.77% of acid.

TINTA VALDEPEÑAS.

In southern Spain, where the bulk of the vineyards are planted with white grapes, it is the custom for each proprietor to keep a few red grapes for the making of small quantities of red wine for home use. These red grapes, which are of different varieties in the different districts, are called, indiscriminately, "Tintas." Among these varieties the only one of renown, or which produces a wine which finds its way beyond the place of its production, is the Tinta Valdepeñas.

The red wines of Valdepeñas have been famous since the days of Pliny, and now have the distinction of being the best if not the only good dry red wines of southern Spain. These wines do not seem to be all produced by the same grape. According to Portes and Ruyssen, many of the vineyards are planted with Burgundy grapes. The variety which has been imported into California, and which is described below, is, however, probably a native of Valdepeñas.

Description.—Leaves of medium size, coarsely and somewhat acutely dentate, deeply lobed, the upper sinuses very deep and often closed, the lower less deep but well marked, the petiolar quite closed; upper surface dark green, glabrous except when quite young, the lower grayish green, with fine tomentum and well-marked ribs; tips of the shoots yellowish and pubescent; bunches of medium size, conico-cylindrical, slightly shouldered, and close; berries of good size, round, with thick and very astringent skin; peduncles herbaceous and slender, pedicels slender and about half the length of the berries, which are covered with an abundant bloom.

The description which modern authorities give of the red wines of Valdepeñas is identical with that given by Cervantes. They are, according to this author, heavy-bodied, with full vinosity and a slightly bitter taste.

In California this Tinta has made some excellent dry wines. The grapes attain a rather high degree of sugar and rather low acid, but ferment without much trouble. In the coast counties the wine is deeply colored, heavy-bodied, alcoholic, astringent, and of good quality, but not marked character. At Tulare this grape has given one of the best dry red wines of the district. It has sufficient and stable color, good vinosity, some bouquet, and clean taste. As in Spain, the wine is slightly but not unpleasantly bitter. It is evidently one of the red grapes most suited to the hotter parts of the State for the production of dry red wines. It is not a success for sweet wines, which are too rough and astringent.

ANALYSES OF MUSTS AND WINES.

TINTA VALDEPEÑAS.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
1890—No. 1402.	J. T. Doyle, Cupertino	Oct. 19	19.80		.61							
1892—No. 1634.	Tulare	Aug. 6	23.90		.24							
1893—No. 1902.	Tulare	Sept. 29	24.55	23.61	.38	.49	9.56	11.91	.262	.46	.48	3.60
No. 1924.	Paso Robles	Oct. 12	25.20	23.60	.41	.37	9.49	11.82	.205	.41	.56	3.10
No. 2041.	J. T. Doyle, Cupertino	Oct. 30	26.90		.54				.320			
1894—No. 2156.	Tulare	Sept. 17	25.10	24.64	.38				.222	.41	.35	2.95

COLOR READINGS.

TINTA VALDEPEÑAS.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1893—No. 1902.	Tulare	30.5 1VR	13.1 4VR	14.0 5VR	11.5 1R	11.5 2R	9.8 2R
No. 1924.	Paso Robles	37.4 VR	18.7 5VR	17.1 3VR	16.3 4VR	12.5 1R	11.0 1R
No. 2041.	Cupertino	129.0 1-2VR					
1894—No. 2156.	Tulare	38.4 1VR	19.4 4VR	18.0 5VR	12.0 3R		

RECORD OF TREATMENT.

No. 1402. *Tinta Valdepeñas*, from Cupertino. A sample for must analysis was received October 21, 1890. The grapes were in fair condition, but some were shriveled. The must showed 19.8% of solid contents by spindle and 0.61% of acid.

No. 1634. *Tinta Valdepeñas*, from Tulare station. A sample for must analysis was received on September 6, 1892, in good condition. The must showed 23.9% of solid contents by spindle and 0.24% of acid.

No. 1902. *Tinta Valdepeñas*, from Tulare station. Received September 29, 1893, in good condition, but a little overripe. The bunches were of medium size, conico-cylindrical, slightly shouldered, and close; the berries were of good size, round, with thick and very astringent skin; the peduncles were green and rather slender, the pedicels slender and about half the length of the berries, which were covered with abundant bloom. The composition of the must was 24.55% of solid contents by spindle and 0.38% of acid. The temperature of the grapes at crushing was 66°, and the maximum of 88° was reached on the fifth day. On the sixth day the murk was dry, and was drawn off.

At one month the wine was nearly clear, of good flavor, body, and high astringency. Two weeks later it was quite clear, tasted sound, but still contained a little sugar. At this date it was racked and taken to the cellar. At four months it was bright and nearly dry, with little bouquet, but of good body, tannin, and alcohol, and moderate acid—generally an agreeable wine, but a little flat. At seven months it had been racked three times, and was in good order and retained its good quality. At eleven months it had developed some bouquet and had improved generally. A week later the lees were examined and a few filaments found; the wine, however, was unaffected in taste, was nearly mature, and, considering the smallness of the sample, had kept very well. At seventeen months the wine was mature, retained its good qualities, and was bottled. One year from bottling the wine was bright, without deposit, clean-tasting, but with a slight bitterness. It had a little bouquet, good flavor, and full alcoholic strength. It was one of the best of the Tulare wines.

No. 1924. *Tinta Valdepeñas*, from Paso Robles station. Received October 12, 1893, in good condition. The grapes were somewhat overripe and shriveled; the bunches and berries were very small. The must showed 25.2% of solid contents by spindle and 0.41% of acid. There were only 40 pounds of grapes, and the fermentation, which started at 70°, was cool. It lasted five days, when the murk was drawn off quite dry.

Three weeks after pressing, the wine was nearly clear, full bodied, well flavored, with good astringency and moderate acid. It was racked twice, and became quite clear, but the smallness of the sample prevented it from being kept any length of time.

No. 2041. *Tinta Valdepeñas*, from Cupertino. Received October 31, 1893, in good condition. The bunches were large, conical, loose, on somewhat slender peduncles; the berries were large, nearly round, fleshy, on slender pedicels, and overripe. The must showed 26.9% of solid contents by spindle and 0.54% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF JURA TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Sirah.										
1242	Fresno	1890	25.10	24.11	.43	.37	12.36	.244	.30	.48	2.70
1472	Fresno	1891	25.20	------	.48	------	12.36	.240	.51	.43	3.35
1278	Cupertino	1890	24.15	------	.67	------	------	------	------	------	------
1370	Cupertino	1890	24.15	------	.52	------	------	------	------	------	------
2044	Cupertino	1893	28.60	------	.58	------	------	.502	------	------	------
2052	Cupertino	1893	28.20	------	.58	------	------	.553	.79	------	------
1296	Mission San José	1890	25.30	------	.84	.22	12.46	.259	.71	.45	3.45
1341	Mission San José	1890	25.40	------	.64	.19	13.00	.301	.44	.38	3.32
1564	Mission San José	1891	27.35	------	.65	------	15.20	.411	.71	.43	3.20
1708	Mission San José	1892	23.25	23.13	.78	.35	11.55	.335	.83	.70	2.95
1952	Mission San José	1893	24.60	------	.94	------	------	.345	.77	------	------
2076	Mission San José	1893	28.80	25.65	.63	.30	13.36	.256	.65	.67	3.30
2254	Mission San José	1894	23.70	------	.64	------	------	.236	------	------	------
2269	Mission San José	1894	23.70	------	.68	------	------	.245	------	------	------
1438	Tulare	1891	25.65	------	.37	------	------	------	------	------	------
1616	Tulare	1892	23.70	22.23	.43	.30	------	------	------	------	------
1635	Tulare	1892	25.10	------	.41	------	------	------	------	------	------
1814	Tulare	1893	22.40	21.80	.62	.50	10.36	.141	.47	.51	3.20
2139	Tulare	1894	21.50	20.83	.65	------	11.00	.159	.58	.44	2.85
2153	Tulare	1894	24.00	------	.53	------	------	------	------	------	------
1488	Paso Robles	1891	23.70	------	.50	------	------	------	------	------	------
1492	Paso Robles	1891	24.80	------	.53	------	------	------	------	------	------
1647	Paso Robles	1892	23.95	------	.69	------	------	------	------	------	------
1879	Paso Robles	1893	22.60	20.99	.53	.43	------	.237	.46	------	------
1895	Paso Robles	1893	25.85	25.53	.51	.37	12.36	.211	.51	.50	3.30
1664	Amador station	1892	26.40	------	.42	------	------	------	------	------	------
2286	Amador station	1894	23.50	------	.48	------	------	------	------	------	------
	Average, Fresno	------	**25.15**	**24.11**	**.45**	**.37**	**12.36**	**.242**	**.40**	**.45**	**3.03**
	Average, Cupertino	------	**26.28**	------	**.59**	------	------	**.528**	**.79**	------	------
	Average, Mission San Jose	------	**26.01**	**24.39**	**.72**	**.26**	**13.11**	**.298**	**.68**	**.52**	**3.24**
	Average, Tulare	------	**23.72**	**21.62**	**.50**	**.40**	**10.68**	**.150**	**.53**	**.48**	**3.02**
	Average, Paso Robles	------	**24.18**	**23.26**	**.55**	**.40**	**12.36**	**.224**	**.48**	**.50**	**3.30**
	Average, Amador station	------	**24.95**	------	**.45**	------	------	------	------	------	------

SUMMARY OF ANALYSES OF MUSTS AND WINES OF JURA TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Mondeuse.										
1312	Cupertino	1890	20.40		.79	.21	9.73	.237		.45	2.70
2037	Cupertino	1893	23.10		.69			.432		.98	
1334	Mission San José	1890	21.70		.76	.21	11.00	.294	.58	.50	2.58
1563	Mission San José	1891	22.15		.68		11.09	.259	.77	.53	2.30
1582	Mission San José	1891	22.60	22.22	.53		11.45	.272	.68	.43	2.70
1764	Mission San José	1892	19.75	19.54	.72		9.73	.256	.84	.74	2.60
2062	Mission San José	1893	22.60	21.40	.65	.21	10.36	.301	.74	.62	2.60
2264	Mission San José	1894	20.50		.57			.203			
1595	Kenwood	1891	23.70	22.22	.48	.33	12.18	.375	.58	.50	3.35
1617	Tulare	1892	22.30	21.80		.35					
1888	Tulare	1893	20.20	19.08	.45	.31	9.73	.256	.53	.46	2.30
2206	Tulare	1894	23.60		.47						
1729	Paso Robles	1892	22.05		.47						
1922	Paso Robles	1893	22.60	21.38	.45	.30	10.25	.195	.53	.70	3.60
2216	Paso Robles	1894	22.30		.53						
2174	Amador station	1894	21.50		.56						
	Average, Cupertino		**21.75**		**.74**	**.21**	**9.73**	**.335**		**.72**	**2.70**
	Average, Mission San Jose		**21.55**	**21.05**	**.65**	**.21**	**10.73**	**.262**	**.72**	**.56**	**2.55**
	Average, Tulare		**22.03**	**20.44**	**.46**	**.33**	**9.73**	**.256**	**.53**	**.46**	**2.30**
	Average, Paso Robles		**22.32**	**21.38**	**.48**	**.30**	**10.25**	**.195**	**.53**	**.70**	**3.30**
	César.										
1594	Kenwood	1891	26.50	26.31	.50	.37	13.54	.544	.50	.40	3.35
	Etraire de L'Adhui.										
1395	Cupertino	1890	29.10		1.15						
2118	Cupertino	1893	25.70		.77			.352	.62		
2298	Mission San José	1894	23.50		.75			.153	.75		
	Average, Cupertino		**27.40**		**.96**			**.352**	**.62**		

	Tinta Valdepeñas.										
1402	Cupertino	1890	19.80		.61						
2041	Cupertino	1893	26.90		.54			.320			
1634	Tulare	1892	23.90		.24						
1902	Tulare	1893	24.55	23.61	.38	.49	11.91	.262	.46	.48	3.60
2156	Tulare	1894	25.10	24.64	38			.222	.41	.35	2.95
1924	Paso Robles	1893	25.20	23.60	.41	.37	11.82	.205	.41	.56	3.10
	Average, Cupertino		**23.35**		**.58**			**.320**			
	Average, Tulare		**24.52**	**16.08**	**.33**	**.49**	**11.91**	**.242**	**.44**	**.42**	**3.28**

SOUTHERN FRENCH TYPE.

(See Vit. Rept. 1887-89, p. 166.)

The conditions of the vast vine-growing district of Southern France are such as to make the production of large quantities of wine of medium quality more desirable than smaller quantities of high-class wines. We thus find that all the varieties of vines cultivated extensively there are heavy bearers and produce wines more suitable to blending purposes than for direct consumption. Of these varieties several have been planted extensively in California, and in many cases have given excellent results.

The *Carignane* and *Mataro*, which are the most extensively cultivated in France, have been given a large place in California vineyards. They give good results, however, only on warm, well-drained soils and in early localities. Contrary to the experience in France, the Carignane gives here, in almost every case, a wine of higher quality than the Mataro. On rich, low soils, though it bears well, it gives a poor wine, lacking in color and quality.

The *Grenache* and *Mourastel* cannot be recommended for any locality yet tried, though the former has been used to make some fair sweet, white wines. The *Ploussard* may be considered as a failure.

The *Cinsaut* is not well adapted to the cooler portions of the State, where its sugar content does not go sufficiently high; but it is a heavy and regular bearer, and in the hot valleys would probably develop the qualities for which it is noted in France. On account of its handsome aspect and pleasant flavor, it would be useful to a limited extent as a table grape for local markets.

The *Aramon* is worthy of further trial, and will doubtless be of use for the production of light, red wines in some localities. In the hot central valleys it makes a fair wine, easily fermented, but totally lacking in color, and generally too light and thin. In the cooler coast counties it generally fails to ripen properly; but in early seasons, when the crop is moderate, it makes a very agreeable light wine, with brilliant and sufficient color. In the warmer exposures of the earlier parts of the coast counties it will make a good light wine for early consumption, as it matures very quickly. It will doubtless be found useful for blending with heavier wines.

The *Petit Bouschet* has not been an unqualified success. As a coloring grape it is equaled or surpassed by grapes of higher quality in localities where the production of color is difficult; while in other localities its coloring properties are not needed, and its wine is not generally of high enough quality, to be worth growing for itself in the presence of superior kinds. The best results that have been obtained with it have been on heavy clay soils.

The *Bastardo* and *Trousseau*, which closely resemble each other, may be considered as of doubtful value under our conditions.

The *Beclan* is placed in this category on account of the character of its wine, which, though suitable for blends with fine wines, resembles the Southern French wines in its smoothness, low acidity, and neutrality. It is for this reason an excellent grape to plant in connection with the rougher Medoc or Jura grapes, to soften and diminish their too intense character.

ARAMON.

(See Vit. Rept. 1883-85, p. 105; 1887-89, p. 166.)

The later analyses of this variety show that the deficiency in acid noticed at first was in all probability due to the youth of the vines, as since then it has shown from medium to full acid at all localities. The average composition of the must has been: at Mission San José, sugar 22.35%, acid 0.62%; and at Cupertino, sugar 22.3%, acid 0.52%. At Tulare this vine is a strong grower and immense bearer, yielding eight to ten tons per acre with short-pruning. As much as 84 lbs. have been taken from one vine in the row. The grapes attain a fair amount of sugar and acid, considering the size of the crop, but when the crop is very large they are very deficient in tannin. The grapes have the pleasant astringent taste so characteristic of the Aramon, but the percentage of skin is so small that the wine is seldom astringent enough when made up pure. The wine is also almost totally lacking in color and low in body. As a blending wine it is useful, on account of the productiveness of the vine, and because of its agreeable and somewhat delicate flavor. Blended with one third Tinta Amarella and one sixth Petit Bouschet, it has given good results. The indications are that it is better suited to the production of white wines than of red. At the Amador station in the foothills the Aramon is a healthy, strong grower, and yields regularly about four tons per acre with short-pruning. It gives more sugar than at Tulare, and has sufficient color.

ANALYSES OF MUSTS AND WINES.

ARAMON.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1246.	Fresno	Aug. 24	21.10	20.99	.65	.36	8.48	10.58	.248	.50	.39	2.82
No. 1377.	Mission San José	Oct. 18	22.10	......	.81	.29	9.20	11.45	.149	.71	.36	2.58
No. 1414.	Cupertino	Oct. 28	23.00	......	.51	.22	9.78	12.18	.298	.62	.44	2.82
1891—No. 1436.	Tulare	Aug. 24	20.20	......	.53	......	......	......	......	......	......	......
No. 1474.	Fresno	Aug. 28	21.50	......	.57	......	8.34	10.42	.210	.66	.44	2.60
1892—No. 1639.	Tulare	Sept. 12	21.50	20.44	.57	.34	8.84	11.00	.242	.53	.44	2.65
No. 1659.	Amador station	Sept. 16	20.30	......	.76	......	......	......	......	......	......	......
No. 1755.	Paso Robles	Oct. 12	21.50	......	.48	......	......	......	......	......	......	......
1893—No. 1826.	Amador station	Sept. 7	18.60	......	.86	.23	......	......	.182	.86	......	......
No. 1918.	Tulare	Oct. 9	21.50	19.21	.74	.44	7.92	9.90	.147	.68	.47	2.60
No. 2054.	Cupertino	Nov. 1	23.40	......	.62	......	......	......	.345	.79	......	......
1894—No. 2178.	Amador	Sept. 24	20.40	......	.67	......	......	......	......	......	......	......
No. 2290.	Tulare	Oct. 11	22.85	21.80	.48	......	8.48	10.58	.052	.56	......	2.65
No. 2290*a*.	Tulare	Oct. 11	22.85	21.80	.48	......	......	10.75	.285	.42	.58	2.60
No. 2299.	Mission San José	Oct. 13	22.80	......	.61	......	......	......	.147	.72	......	......
No. 2316.	Amador station	Oct. 15	23.40	......	.45	......	......	......	......	......	......	......

COLOR READINGS.

ARAMON.		At Pressing.		One Month.		Two Months.		Three Months.	
1891—No. 1474.	Fresno	3.33	5VR+Y	Too light to be read on scale.					
1892—No. 1639.	Tulare	Too light to be read on scale.							
1893—No. 1826.	Amador station	21.0	4VR	......		......		......	
No. 1918.	Tulare	6.1	VR+Y	......		......		......	
No. 2054.	Cupertino	34.8	1-2VR	......		......		......	
1894—No. 2290*a*.	Tulare*	36.0	1VR	27.2	1-2VR	18.6	5VR	16.3	4VR
No. 2299.	Mission San José	38.0	1VR	......		......		......	

Blend ⅓ Aramon, ⅓ Tinta Amarella, ⅓ Petit Bouschet.

RECORD OF TREATMENT.

No. 1246. *Aramon*, from Margherita Vineyard, Fresno. Received August 26, 1890, in good condition, and mature. The must showed 21.1% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the maximum reached was 82°, on the third day. The murk was dry on the fifth day, when it was drawn off.

In three weeks the wine was nearly clear, and was racked. At three months it was clear, almost without color, of neutral but rather pleasing flavor, no bouquet, full astringency, and medium acid. A few days later lactic ferments were found in the lees, and the wine was pasteurized. At eight months it was clear, thin, and characterless, but with agreeable astringency. At fifteen months it was bright, with little bouquet or flavor, perfectly neutral, but still agreeable, and nearly mature. At seventeen months it was bottled. At three years the bottled wine was tasted, and found bright and in good condition, of a dark straw color, agreeably astringent, but without quality.

No. 1377. *Aramon*, from Mission San José. Received October 20, 1890, in fair condition; a few grapes were moldy, the bunches large and well filled. The must showed 22.1% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum reached was 96°, on the fourth day. The murk was dry on the fifth day, when it was drawn off.

In one month the wine was nearly clear, with pleasant flavor and aroma, medium acid and astringency; in general, of good quality. It remained sound and in good condition for four months, when the after-taste had become a little suspicious, so the wine was pasteurized. It improved slightly for about ten or twelve months, after which it commenced to deteriorate, and soon became flat and poor. It was bottled at eighteen months, but did not improve in glass.

No. 1414. *Aramon*, from J. T. Doyle, Cupertino. Received October 30, 1890, in good condition. The must showed 23.0% of solid contents by spindle. The temperature of the grapes at crushing was 68°, and the maximum reached was 93°, on the third day. The murk was nearly dry on the fourth day, when it was drawn off.

In one month the wine was not quite clear, had good flavor and aroma, low acid, and full astringency. At three months it was clear, with pleasing bouquet and full flavor, still rough, but of good quality and with sufficient alcohol and body. After this the wine did not improve, and soon commenced to deteriorate. The wine was racked three times during the first year, and remained bright. The wine was bottled, part at sixteen and part at twenty-two months. At three years the bottled wines were tasted and found bright, fairly agreeable, but lacking in character and showing some bad acid.

No. 1436. *Aramon*, from Tulare station. A sample for must analysis was received August 27, 1891, in good condition. The must showed 20.2% of solid contents by spindle.

No. 1474. *Aramon*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition. The must showed 21.5% of solid contents by spindle. The temperature of the grapes at crushing was 70°, and the maximum reached was 80°, on the third day. The murk was still a little sweet on the seventh day, when it was drawn off.

The wine was a little slow in clearing, but was clear in six weeks from crushing, clean-tasting, and with some flavor and aroma. It was racked three times during the first year, and remained in good order. It was at its best at about six months, when it was a light, agreeable, somewhat acid wine, sound, but with little character. After this it deteriorated, owing partly to the smallness of the sample. At sixteen months it was bottled; it had lost nearly all its color and looked like a white wine. At three and a half years the bottled wine was bright, without deposit; had good flavor, a little bouquet, and sufficient tannin; an agreeable wine but for slight odor of volatile acid.

No. 1639. *Aramon*, from Tulare station. Received September 15, 1892, in good condition. The must showed 21.5% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum reached was 97°, on the fourth day. The murk was not quite dry on the fourth day, when it was drawn off.

In one month from crushing the wine was nearly clear, dry, and was racked and taken to the cellar. At four months it was nearly bright, with little bouquet, flavor, or color, but with full astringency and clean taste, promising to be a good neutral wine. It was racked for the second time at eight months, and after this did not improve, but lost all its color and became flat. At fifteen months it was bright, but flat, and not nearly as good a wine as the Carignane or Petit Bouschet of the same locality. It was bottled at nineteen months.

No. 1659. *Aramon*, from Amador station. A sample for must analysis was received September 19, 1892, in poor condition. The must showed 20.3% of solid contents by spindle.

No. 1755. *Aramon*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 21.5% of solid contents by spindle.

No. 1826. *Aramon*, from Amador station. Received September 8, 1893, in good condition. The bunches were small; the berries were small and not mature. The must showed 18.6% of solid contents by spindle.

No. 1918. *Aramon*, from Tulare station. Received October 9, 1893, in good condition. The bunches were irregular, large, well filled, but not close; the berries were very large. round, with little color, firm, juicy, mature, but not very sweet. The must showed 21.5 of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum reached was 95°, on the third day.

In three weeks the wine was nearly clear, and had very little color. In three months it was clear, clean-tasting, had a little bouquet and flavor, medium astringency, and low acid; in general, was a fair wine, but with hardly any color. At four months it was racked for the second time; at six months it had not improved much, and lacked bouquet and freshness.

No. 2054. *Aramon*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were over medium size, conical, well filled; the berries were large, round, crisp, juicy, and well colored. The must showed 23.4% of solid contents by spindle.

CINSAUT.

(See Vit. Rept. 1883-85, p. 104; 1885-86, p. 84; 1887-89, p. 212.)

Further experiments with the Cinsaut have confirmed its unsuitableness for the production of any but very common wines in the Bay region, if used alone. It is possible, however, to improve it very much and to make a very fair wine by judicious addition of some other grape in the fermenting-vat. No. 1789, a blend of 80% Cinsaut with 20% Alicante Bouschet, was a good ordinary wine with medium acid, astringency, and body, and good color. It had little character, but was smooth and pleasing. At Tulare the vine is a strong grower and good bearer, resisting alkali well and giving from six to seven tons per acre. On account of the large size and compactness of the bunches the grapes are subject to injury by the black mold (*Aspergillus niger*), which in the lower part of the San Joaquin Valley is so destructive to Zinfandel and other thin-skinned grapes with close bunches. The must attains a fair amount of sugar and medium acid, and ferments well. The wine is almost without color, of pleasant flavor, very low in tannin, and a poor keeper. It could doubtless be much improved by an addition of Refosco or Petit Bouschet. It makes a better white than red wine, but in this case also it is much improved by cutting with another wine, for instance with Burger. So far, the vines have not borne well at Paso Robles, nor at the Amador station, and at the latter they have been subject to coulure.

ANALYSES OF MUSTS AND WINES.

CINSAUT.		Date of Picking.	MUST.				WINE.					
			Solid Contents by Spindle.	Sugar by Copper Test.	Acid as Tartaric.	Ash.	Alcohol. By Weight.	Alcohol. By Volume.	Tannin.	Total Acid as Tartaric. At Pressing.	Total Acid as Tartaric. At Six Months.	Body.
1890—No. 1408.	Mission San José	Oct. 26	22.35		.44	.21	9.92	12.36	.122		.41	2.58
1891—No. 1434.	Tulare	Aug. 24	25.20	24.22	.52	.64	9.86	12.00	.120	.42	.30	3.80
No. 1477.	Paso Robles	Aug. 30	18.60		.58							
1892—No. 1614.	Tulare	Aug. 26	22.05	22.24	.58		8.77	10.90	.103	.43	.47	2.95
No. 1655.	Paso Robles	Sept. 13	22.60		.57							
No. 1789.	Mission San José	Oct. 19	22.10		.53		9.56	11.91	.196	.60	.50	2.70
1893—No. 1825.	Amador station	Sept. 7	21.05		.69				.284	.83		
No. 1842.	Tulare	Sept. 11	21.95	20.24	.62	.37	8.84	11.00	.083	.52	.49	2.60
No. 2050.	Cupertino	Nov. 1	19.10		.61				.467	.79		
1894—No. 2138.	Tulare	Sept. 10	22.00	21.38	.47		8.48	10.58	.136	.42	.42	2.60
No. 2159.	Amador station	Sept. 17	26.50		.45							
No. 2307.	Mission San José	Oct. 13	20.85		.44							

COLOR READINGS.

CINSAUT.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1434.	Tulare	7.8	5VR+Y	5.5	VR+2Y	3.3	3R+2Y						
1892—No. 1614.	Tulare	5.5	2VR+Y	3.8	5VR+2Y								
No. 1789.*	Mission San José	62.5	1VR	57.1	1VR	52.0	2VR	34.5	3VR	31.0	3-4VR	29.2	3-4VR
1893—No. 1825.	Amador station	45.6	1VR										
No. 1842.	Tulare	4.2	1R	6.2	1VR+Y								
No. 2050.	Cupertino	30.8	1-2VR										
1894—No. 2138.	Tulare	10.0	3R+Y	4.4	(Y)	4.2	(Y)	4.1	(Y)				

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* Blend of Cinsaut and Alicante Bouschet.

Record of Treatment.

No. 1408. *Cinsaut*, from Mission San José. Received October 29, 1890, in good condition, and mature. The must showed 22.35% of solid contents by spindle and 0.44% of acid. The temperature of the grapes at crushing was 68°. The fermentation was carried on in a closed vat, and without foulage. At the end of two weeks the vat was opened; the cap was hard and smelled perfectly sound; the space above was filled with gas, and the wine was quite dry.

In one month the wine was clear, of pleasing flavor and aroma, clean taste, low acid, and medium astringency; in general, the wine was very agreeable. Two weeks later it was racked in good order, and the lees seemed to be sound. At three months, however, the lees showed many filaments and the taste was affected. The wine was pasteurized, but remained flat and quite ceased to improve.

No. 1434. *Cinsaut*, from Tulare station. Received August 27, 1891, in good condition. The must showed 25.2% of solid contents by spindle and 0.52% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 92°, on the fourth day. On the sixth day the murk was dry, and was drawn off.

In three weeks the wine was nearly clear and quite dry. A month later it had become a little cloudy, and tasted bitter and suspicious of secondary fermentations; it was pasteurized, and at four months was clear; it had developed some bouquet, but tasted thin and insipid. After this it gradually deteriorated, and at nine months it had lost nearly all its character and was quite valueless.

No. 1477. *Cinsaut*, from Paso Robles station. A sample for must analysis arrived in good condition September 3, 1891. The grapes were not quite mature; the berries were rather small for the variety, but well colored and the bunches well filled. The must showed 18.6% of solid contents by spindle and 0.58% of acid.

No. 1614. *Cinsaut*, from Tulare station. Received August 29, 1892, in good condition, except for a few bunches covered with black mold, which were rejected; some bunches were not quite mature. The must showed 22.05% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 96°, on the fifth day. On the seventh day the murk, being nearly dry, was drawn off.

In one month the wine was clear, clean-tasting, and perfectly dry. At four months it had been racked twice, and was clear, but had an unpleasant odor; the lees were sound. At six months the wine was clear and had changed little, but the lees showed some filaments, and it was therefore pasteurized. After this it gradually deteriorated, becoming flat and insipid.

No. 1655. *Cinsaut*, from Paso Robles station. A sample for must analysis was received September 16, 1892. The must showed 22.6% of solid contents by spindle and 0.57% of acid.

No. 1789. *Cinsaut*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 22.1% of solid contents by spindle and 0.53% of acid. The temperature of the must at crushing was 64°, and the maximum reached was 87°, on the third day. On the fourth day the murk was dry, and was drawn off. This sample was fermented with No. 1790 in the proportion of 80% of Cinsaut to 20% of Alicante Bouschet.

The wine was racked one month after pressing, and at three months was clear, clean-tasting, but still a little sweet. At five months it was in good condition, smooth, full-bodied, not quite dry, but sound both according to taste and to the microscopic examination of the lees. At seven months it was racked for the second time, and the lees were found still sound. At fourteen months the wine was bright, perfectly dry, smooth, and pleasing, with little bouquet or flavor, but agreeable acid and astringency. It was mature, and part of it was bottled; the rest was bottled at eighteen months.

No. 1825. *Cinsaut*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition; the bunches were loose and coulured, the berries small. The must showed 21.05% of solid contents by spindle and 0.69% of acid.

No. 1842. *Cinsaut*, from Tulare station. Received September 12, 1893, in good condition. The bunches were large, well filled, and unevenly colored, the larger bunches having berries with hardly any color at all; the berries were very fine and large, and tasted mature. The must showed 21.95% of solid contents by spindle and 0.62% of acid. The grapes were pressed and the must fermented for white wine. The temperature of the must at starting was 66°, and the maximum reached was 87°, on the second day. The wine was dry on the fourth day, and on the tenth was racked.

In three weeks the wine was nearly clear, fresh, and clean-tasting. At four months it was a passable wine, without character, but with no defect except a slight bitterness. At five months it was racked for the third time; it was much improved, very smooth, and clean-tasting. At twelve months it had not changed much; it had developed a little bouquet, and was in good condition. The acid was rather low, and a blend with two-fifths Burger (No. 1908) made a great improvement.

No. 2050. *Cinsaut*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were over medium in size, long-conical, well filled; the berries large, oval, juicy, mature, well colored. The must showed 19.1% of solid contents by spindle and 0.61% of acid.

GRENACHE.

(See Vit. Rept. 1883–85, p. 107; 1887–89, p. 206.)

The Grenache is characterized in most localities by vigorous growth and abundant foliage, and when not injured by mildew or coulure it is a heavy bearer. When pruned short in the ordinary way it is apt to shade its grapes too much; and, especially in moist seasons, if not well sulphured, is very subject to mildew. In Santa Clara, Alameda, and San Diego counties it is reported as being very subject to coulure. At Fresno it bears well and develops high sugar and medium acid; the average of five analyses is, sugar 25.9% and acid 0.45%.

At Tulare the vine is a strong grower and bears from six to ten tons per acre in the somewhat alkaline, sandy soil in which it is planted. The composition of the must has been good and fairly constant, varying little from the average of 23.5% of sugar and 0.50% of acid shown by four analyses. It ferments well, but makes a neutral wine almost totally lacking in color, with little quality, and much inferior to that of Refosco from the same vineyard. Its chief merits are vigor and heavy bearing, and in the latter, at least, it is surpassed by the Petit Bouschet, a much preferable grape.

At Paso Robles the composition of the must is practically the same as at Tulare as regards sugar and acid, but it makes a wine of somewhat better quality, though still lacking in color and quality.

At the Amador station the vine is a strong grower and good bearer, but somewhat inclined to coulure.

One of the disadvantages of the wine of this grape is the peculiar "burnt-sugar" flavor which it carries into all blends not strongly flavored otherwise, and which is not generally liked.

ANALYSES OF MUSTS AND WINES.

GRENACHE.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1249.	Fresno	Aug. 25	24.10	23.72	.57	.40	9.70	12.09	.153	.55	.46	3.02
No. 1333.	Cupertino	Oct. 11	24.35		.62							
1891—No. 1444.	Tulare	Aug. 26	22.60		.53							
No. 1527.	Paso Robles	Oct. 5	24.40	24.12	.45		9.70	12.09	.180		.40	2.55
1892—No. 1626.	Tulare	Sept. 3	23.25	23.13	.47	.35	9.41	11.73	.172	.55	.48	2.90
No. 1721.	Paso Robles	Oct. 10	22.60	22.23	.56	.45	9.05	11.27	.146	.50	.55	2.85
1893—No. 1822.	Amador station	Sept. 7	23.25		.74				.288	.80		
No. 1845.	Tulare	Sept. 14	22.80	20.61	.53	.33	8.84	11.00	.109	.52		2.70
No. 2010.	Paso Robles	Oct. 26	28.20	27.65	.51	.29	11.08	13.54	.224	.51	.60	2.85
1894—No. 2170.	Tulare	Sept. 24	25.10	24.97	.47		10.44	12.91	.150	.40	.44	2.85
No. 2193.	Amador station	Sept. 25	28.00		.46							

COLOR READINGS.

GRENACHE.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1891—No. 1527.	Paso Robles	18.0	R-1R	9.3	1R	4.0	2R+Y								
1892—No. 1626.	Tulare	20.0	2R	10.5	1VR+Y	10.0	1VR+Y	9.3	3VR+Y	6.3	3R+Y			5.7	3R+Y
No. 1721.	Paso Robles	28.8	2VR	18.1	5VR	14.3	R	11.1	R	9.1	R	7.8	R		
1893—No. 1822.	Amador station	22.0	5VR												
No. 1845.	Tulare	3.8	2R+2Y												
No. 2010.	Paso Robles	24.4	3VR	10.4	1R	9.6	1R	10.2	1R	10.0	R				
1894—No. 2170.	Tulare	Color too light and too yellow to be read on the scale.													

RECORD OF TREATMENT.

No. 1249. *Grenache*, from Margherita Vineyard, Fresno. Received August 27, 1890, in good condition, and mature. The must showed 24.1% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum reached was 78°, at which temperature it remained during the fourth and fifth days. The fermentation was slow in starting and tardy in finishing; the murk was drawn off on the seventh day while still sweet, and the fermentation continued in the cask; six days after pressing the wine was quite dry.

At ten weeks the wine was of fair quality and bright, the color was light, and the wine had little flavor or aroma, but was clean-tasting and with good acid and tannin. A month later the wine was racked for the second time, and soon after an examination of the lees showed the presence of a little lactic ferment, but the taste was unaffected, and the wine, having developed a little bouquet, had improved generally. It was pasteurized for safety. After this the wine did not improve much, but remained bright, and a coarse but drinkable wine. At eighteen months it was mature, and was bottled. At three years the bottled wine was tasted; that bottled at eighteen months was in good condition, but had lost nearly all its red color and was of deep straw color; it was without any positive defect, but lacked freshness and character. Some of the wine bottled earlier had retained some color, but had not kept well.

No. 1333. *Grenache*, from J. T. Doyle, Cupertino. Received October 13, 1890, in good condition, and mature. The must showed 24.35% of solid contents by spindle and 0.62% of acid.

No. 1444. *Grenache*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 22.6% of solid contents by spindle and 0.53% of acid.

No. 1527. *Grenache*, from Paso Robles station. Received October 7, 1891, in good condition. The must showed 24.4% of solid contents by spindle and 0.45% of acid. The grapes were fermented with No. 1528, Mourastel, from the same vineyard. The temperature of the grapes was 64° at crushing, and reached a maximum of 86° on the third day. On the fifth day the murk was nearly dry, and was drawn off.

At one month from pressing the wine was clear, had a little aroma and flavor, was smooth, but tasted a little flat. During the first three months the wine was racked twice; the lees were examined and found to be sound. At five months the wine was clear and sound, but flat, characterless, and of poor quality. It was racked three times during the next twelve months, and remained clear, but improved very little in quality. At fifteen months it was bottled. The wine improved considerably in bottle, and at three and a half years was a fair wine, but rather thin, and lacking in color and flavor.

No. 1626. *Grenache*, from Tulare station. Received September 6, 1892, in fair condition. The must showed 23.25% of solid contents by spindle and 0.47% of acid. The temperature of the must at crushing was 68°, and the maximum reached was 99°, on the fourth day. On the sixth day the murk was nearly dry, and was racked off.

At one month the wine was nearly clear, very promising, but still a little sweet. Two weeks later it was clear and nearly dry. At four months it was clear, but still slightly sweet, and not quite clean-tasting. An examination of the lees showed the presence of filaments, and the wine was pasteurized. Two months after pasteurizing it was racked, and was bright and nearly dry, but of poor quality. After this it gradually improved, and remained bright and sound. At nineteen months it was bottled.

No. 1721. *Grenache*, from Paso Robles station. Received October 13, 1892, in good condition; the grapes were small and tasteless. The must showed 22.6% of solid contents by spindle and 0.56% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 82°, on the third day. On the fourth day the murk was nearly dry, and was drawn off.

At one month the wine was racked, being nearly clear, dry, and promising. At three months it was bright, smooth, and pleasing, with moderate acid and astringency. Successive tastings at five, eight, and fourteen months showed a gradual improvement; it kept well, and was sound and pleasant, but lacked character. At eighteen months it was mature, and was bottled.

No. 1822. *Grenache*, from Amador station. Received September 8, 1893, in good condition. The bunches and berries were of fair size, lacking in color and not quite mature. Only a sample for must analysis was received. The must showed 23.25% of solid contents by spindle and 0.74% of acid.

No. 1845. *Grenache*, from Tulare station. Received September 14, 1893, in good condition, and mature. The bunches were of medium size, from well filled to compact, the skin very tough and thick, with very little color. The must showed 22.8% of solid contents by spindle and 0.53% of acid. The temperature of the must at crushing was 68°, and the maximum reached was 93°, on the third day. On the fifth day the murk was nearly dry, and was drawn off.

The wine fermented for some time and remained cloudy, but at the end of a month was nearly clear, and clean-tasting. At five months it was bright, a little sweet, with little bouquet or flavor, but clean-tasting, and was racked for the second time. After this it improved, remaining sound and agreeable. At eleven months it was in good order and had rather more character than the Carignane of the same year and locality (No. 1887), but no more color.

No. 2010. *Grenache*, from Paso Robles station. Received October 26, 1893, in good condition. The bunches were over medium in size, short, cylindrical, from well filled to compact, on very thick peduncles; the berries were of medium size, nearly round, firm, very sweet, and some dried. The must showed 28.2% of solid contents by spindle and 0.51% of acid. The temperature of the grapes at crushing was 62°, and the maximum of 77° was reached on the fifth day. On the fifth day the murk was nearly dry, and was drawn off.

In two weeks the wine was nearly clear, but still a little sweet. It was racked, taken to the cellar, and at two months was quite clear, of good, medium acid and astringency, some flavor, sub-sweet, but sound. At six months it was smooth and agreeable, without much character, but sound and in good order. At nine months it had improved in flavor, but had suffered from the smallness of the sample.

PLOUSSARD.

(See Vit. Rept. 1885–86, p. 82; 1887–89, p. 220.)

The Ploussard has unfortunately only been tested at the Bay region stations. It has proved but a moderate bearer, even with long-pruning, doing the better, in this respect, at Mission San José, of the two stations tried. It has shown some good qualities, but has by no means sustained its French reputation. It makes an alcoholic wine with low to medium acid, deficient astringency, and good body. The color is at first fair, but it quickly falls and turns yellow. The wine develops very quickly, and is at first very agreeable, but is a poor keeper and quickly deteriorates. It might be useful as a blend to give some of its delicacy to coarser varieties, but it ripens one or two weeks before any of the varieties with which it would make appropriate blends. It is an extremely delicious table-grape, and would be useful as an early red eating-grape for consumption near the vineyard, but it is too delicate to bear shipment.

ANALYSES OF MUSTS AND WINES.

PLOUSSARD.	Date of Picking*........	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric ..	Ash	Alcohol.		Tannin........	Total Acid as Tartaric.		Body ....
						By Weight..	By Volume		At Pressing..	At Six Months...	
1890—No. 1261. Mission San José........	Sept. 24	24.80	......	.55	.34	9.78	12.18	.115	.46	.41	2.95
No. 1291. Cupertino........	Oct. 1	25.10	......	.57	.21	......	......	......	......	......	......
1891—No. 1505. Mission San José........	Sept. 24	25.30	25.41	.45	......	10.16	12.64	.188	.41	.42	3.05
1892—No. 1637. Mission San José........	Sept. 10	22.00	......	.57	......	......	......	......	......	......	......
1893—No. 1983. Mission San José........	Oct. 19	25.90	24.75	.56	......	10.81	13.27	.182	.58	.61	2.80

COLOR READINGS.

PLOUSSARD.	At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1891—No. 1505—Mission San José........	13.65 2R	14.3 1VR+Y	13.9 4VR+Y	9.4 3R+Y	9.0 3R+Y	9.6 3R+YY
1893—No. 1983—Mission San José........	29.80 5VR	13.7 2R	13.4 3R	11.8 3R	8.2 (Y)	.. ..

RECORD OF TREATMENT.

No. 1261. *Ploussard*, from Mission San José. Received September 27, 1890, in fair condition, and mature. The must showed 24.8% of solid contents by spindle and 0.55% of acid. The temperature of the must at crushing was 67°, and the maximum reached was 85°, on the fourth day. On the fifth day the murk was drawn off while still a little sweet.

The wine remained cloudy for some time, but at one month it was dry and nearly clear. At two months it was clear, very poor in color, of medium acid and astringency, showing a good flavor somewhat masked by the taste of moldy grapes. At three months it was considerably improved and developed, but as the taste was a little suspicious it was pasteurized. After this it remained bright and lost its moldy taste; it was in a small keg and developed very quickly. At seven months it had some bouquet and was very smooth and agreeable. After this it deteriorated and lost the little color it had to start with. At sixteen months it was bottled, but tasted somewhat thin and exhausted. It did not improve in bottle, but soon became decrepit.

No. 1291. *Ploussard*, from Cupertino. A sample for must analysis was received October 3, 1890, in bad condition, much bruised, and quite mature. The must showed 25.1% of solid contents by spindle and 0.57% of acid.

No. 1505. *Ploussard*, from Mission San José. Received September 27, 1891, in fair condition, a few grapes moldy. The must showed 25.3% of solid contents by spindle and 0.45% of acid. The temperature of the must at crushing was 67°, and the maximum reached was 92°, on the third day. The murk was drawn off on the fourth day, while still a little sweet.

At one month the wine was dry, nearly clear, but tasted flat. An examination of the lees showed the presence of a few filaments, and the wine was pasteurized. At six months it was bright, very light in color, with good body and alcohol, generally improved, and of fair quality. At sixteen months it had been racked three times and was in good order; and, being of fair quality and mature, it was bottled. At three years and a half the bottled wine was bright, with fair but yellowish color, of good flavor, but the bouquet injured by the presence of a little volatile acid.

No. 1637. *Ploussard*, from Mission San José. Received September 13, 1892, in fair condition. The must showed 22.0% of solid contents by spindle and 0.57% of acid. No wine was made.

No. 1983. *Ploussard*, from Mission San José. Received October 19, 1893, in good condition. The bunches were small to medium, loose, and winged; the berries were variable in size, ellipsoidal, and thin-skinned. The sample was very ripe, and many of the grapes dried. The must showed 25.9% of solid contents by spindle and 0.56% of acid. The temperature of the must at crushing was 62°, and the maximum reached, on the fifth day, was 92°. On the sixth day the wine was nearly dry, and was drawn off.

At one month the wine was nearly clear, and was racked and taken to the cellar. At three months it was clear, clean-tasting, with good flavor and some bouquet, good acid and astringency, but was still slightly sweet. During the spring the wine did not taste so well, but became quite dry, and at nine months had improved, was bright, and in good order; generally a good wine, but very poor in color. At this time an examination of the lees showed them to be perfectly sound.

TROUSSEAU.

(See Vit. Rept. 1885-86, p. 82; 1887-89, p. 201.)

Further experiments with the Trousseau show that it will make a fair Port in those localities where a Port is a possibility, but that for other purposes it is more or less a failure. For a dry red wine, without the aid of some other grape, it is quite useless, lacking sufficient color, acid, or tannin. An attempt to make it up into a white wine was little more successful. A sample of Trousseau from Asti, Sonoma County, with full sugar contents and medium acid, was made into white wine, which was rough, coarse, and totally lacking in the freshness which should characterize a white wine, but with better keeping qualities than this variety has when fermented on the skins. Wherever grown, if grown at all, it should be blended in the vat with some grape possessing sufficient acid to insure healthy fermentation.

ANALYSES OF MUSTS AND WINES.

TROUSSEAU.		Date of Picking	MUST.			WINE.							
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body	Sugar
1890—No. 1204.	Fresno	Aug. 12	22.27	22.05	.58	.52	8.84	11.00	.084	.47	.43	2.60	
1891—No. 1458.	Fresno	Aug. 28	27.65		.61		*15.67	19.28	.160	.56	.20	*6.85	
No. 1498.	Asti, Sonoma County	Sept. 14	24.60	23.13	.41	.39	9.78	12.18	.065		.47	2.70	
No. 1510.	Mission San José	Sept. 25	25.20	26.31	.53		*14.64	18.03	.200	.40	.26	*3.03	2.07
1893—No. 1925.	Paso Robles	Oct. 12	26.90	26.12	.26	.34			.176	.38			
1894—No. 2335.	Tulare	Oct. 19	26.80		.30								

* Fortified.

COLOR READINGS.

TROUSSEAU.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.	
1891—No. 1458.	Fresno	5.1	1VR+2Y	3.7	3VR+2Y						
No. 1510.	Mission San José	20.0	1R	9.3	2R+1Y	8.2	1VR+2Y	10.4	1VR+2Y	8.0	1R+2Y
1893—No. 1925.	Paso Robles	10.9	1VR+1Y								

RECORD OF TREATMENT.

No. 1204. *Trousseau*, from Margherita Vineyard, Fresno. Received August 14, 1890, in good condition, but for some moldy bunches. The bunches were of good size for the variety, and well filled; the skin with very little color, and the grapes generally not quite ripe, some of the bunches being quite green. The must showed 22.27% of solid contents by spindle and 0.58% of acid. The temperature of the must at crushing was 69°, and the maximum reached was 86°, on the fourth day. On the sixth day the murk was dry, and was drawn off.

The wine was almost without color and of poor quality, and at three months began to develop a suspicious taste. An examination of the lees showed long filaments, so the wine was pasteurized. After this it became bright, but did not otherwise improve.

No. 1458. *Trousseau*, from Fresno. Received August 31, 1891, in good condition, but slightly dried. The must showed 27.6% of solid contents by spindle and 0.61% of acid. The temperature of the grapes at crushing was 76°, and the maximum reached was 86°, on the third day. On the fourth day the murk was drawn off while still sweet; it fermented slowly in cask for ten days longer, when it was fortified. The wine did not keep well and acquired a bad taste.

No. 1498. *Trousseau*, from Asti, Sonoma County. Received September 17, 1891, in good condition, except for a few moldy bunches. The must showed 24.6% of solid contents by spindle and 0.41% of acid. The grapes were pressed and the must fermented for white wine. The temperature of the must at crushing was 69°, and the maximum reached was 78°, on the third day. It was dry on the seventh day, when it was racked from the lees.

At three weeks the wine was nearly clear and quite dry. At two months it was clear, with little aroma, smooth and pleasing, but without much character and with a slight schiller tint. A month later the lees showed a few filaments and the taste had become very slightly affected; the wine was therefore pasteurized. At six months it had developed some bouquet, but was flat and not of high promise. At nine months it had improved somewhat, and was smooth, oily, full-bodied, but with little character and none of the freshness of a good white wine. After this it was racked twice and was bottled at sixteen months, bright and sound, but coarse and of poor quality. At three and a half years the bottled wine was rough, coarse, and showed that it had been bottled too soon.

No. 1510. *Trousseau*, from Mission San José. Received September 27, 1891, in poor condition, many of the grapes moldy. The must showed 25.2% of solid contents by spindle and 0.53% of acid. The temperature of the grapes at crushing was 67°, and the maximum of 86° was reached on the second day. The murk was drawn off and fortified on the third day.

The wine soon cleared and was of good flavor, but rather too dry. It gradually improved, and at three and a half years was a light-colored, brownish Port, with full, agreeable bouquet and clean taste. On account of the smallness of the sample (three and a half gallons) it matured quickly, and by concentration, due to evaporation, became quite sweet enough. It was rather light in body, but otherwise a good Port.

No. 1925. *Trousseau*, from Paso Robles station. Received October 12, 1893, in good condition, but overripe and many berries dried. The bunches were of medium size, very compact and regular; the berries small, with little juice. The must showed 26.9% of solid contents by spindle and 0.26% of acid. Only a sample for must analysis was received.

BASTARDO.

(See Vit. Rept. 1883–85, p. 119; 1887–89, p. 256.)

There is little to be added to former reports on this variety; as a producer of dry red wine it may be said to be a failure. Its high sugar contents, together with its moderate or low acid, make it a difficult wine to ferment, and a poor keeper. The average composition of the must has been: at Cupertino, 25.6% of sugar, 0.46% of acid; at Mission San José, 25.8% of sugar, 0.55% of acid; at Tulare, 25.7% of sugar, 0.41% of acid. At Paso Robles the sugar content has been lower and the acid higher than these figures, but this is probably in part owing to the youth of the vines. The best use that can be made of this variety is in the manufacture of Ports with the aid of other grapes. At Tulare the vine is a fairly good grower where the alkali is not too strong, but a poor bearer and liable to sunburn.

ANALYSES OF MUSTS AND WINES.

BASTARDO.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1354.	Cupertino	Oct. 12	25.77		.44							
1891—No. 1479.	Paso Robles	Sept. 1	22.90		.43							
1892—No. 1625.	Tulare	Aug. 28	24.80		.41							
No. 1641.	Paso Robles	Sept. 13	22.15		.64							
No. 1709.	Mission San José	Oct. 3	23.70	22.95	.85	.26	9.78	12.18	.262	.53	.39	3.15
1893—No. 1834.	Amador station	Sept. 7	24.80		.72				.358	.68		
No. 1865.	Paso Robles	Sept. 15	23.90	22.95	.49	.34	9.30	11.48	.151	.38	.40	2.80
No. 2047.	Cupertino	Nov. 1	28.00		.63				.252	.75		
1894—No. 2149.	Tulare	Sept. 17	26.50		.41							
No. 2266.	Mission San José	Oct. 5	25.90		.47							

COLOR READINGS.

BASTARDO.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1892—No. 1709.	Mission San José	81.7	VR	40.0	4VR	37.0	5VR	26.8	R	23.8	R	20.8	R
1893—No. 1834.	Amador station	14.9	2R	12.4	3R								
No. 1865.	Paso Robles	10.0	2VR+Y	6.7	VR+Y	5.0	VR+Y						

RECORD OF TREATMENT.

No. 1354. *Bastardo*, from Cupertino. Received October 13, 1890. The must showed 25.77% of solid contents by spindle and 0.44% of acid.

No. 1479. *Bastardo*, from Paso Robles station. A sample for must analysis was received September 3, 1891, in good condition; small, well-filled bunches of small grapes, mature. The must showed 22.9% of solid contents by spindle and 0.43% of acid.

No. 1625. *Bastardo*, from Tulare station. A sample for must analysis was received September 1, 1892, in good condition. The must showed 24.8% of solid contents by spindle and 0.41% of acid.

No. 1641. *Bastardo*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 22.15% of solid contents by spindle and 0.64% of acid.

No. 1709. *Bastardo*, from Mission San José. Arrived October 5, 1892, in fair condition. The must showed 23.7% of solid contents by spindle and 0.85% of acid. The grapes were fermented with No. 1700, Teinturier mâle, from the same vineyard. The temperature of the grapes at crushing was 68°, and the maximum of 97° was reached on the fourth day. On the fifth day the murk was nearly dry, and was pressed.

Three weeks after pressing the wine was clear and dry, but not of high promise. At one month it was racked and taken to the cellar. At two months it was bright, with full, good bouquet and flavor, but not clean-tasting; at this time the wine was of good quality, but was evidently not going to keep well. At four months it had acquired a slight bitterness, but was otherwise little changed. After this, though the wine remained bright and no injurious germs could be found in the lees, it became gradually flat and insipid, till at about fourteen months it was no longer worth keeping.

No. 1834. *Bastardo*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition; the bunches were small and the berries slightly shriveled. The must showed 24.8% of solid contents by spindle and 0.72% of acid.

No. 1865. *Bastardo*, from Paso Robles station. Received September 15, 1893, in good condition; bunches small, compact, without coulure, and evenly ripened. The must showed 23.9% of solid contents by spindle and 0.49% of acid. The temperature of the grapes at crushing was 67°, and the maximum of 85° was reached on the third day. The wine was dry on the fifth day, when it was pressed.

The wine remained cloudy for some time, and continued an almost insensible fermentation. It was racked at one month and again at four months, but, though it became clear, it was flat and insipid. After this it changed little, and at one year it was drinkable, but not a good wine. The lees showed a few filaments.

No. 2047. *Bastardo*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, long conico-cylindrical, close; the berries of medium size, oval, firm, fleshy, very sweet, and just commencing to dry up. The must showed 28.0% of solid contents by spindle and 0.63% of acid.

CHAUCHÉ NOIR.

(See Vit. Rept. 1885-86, p. 79; 1887-89, p. 112.)

This variety resembles the Pinots in its yellowish color and its liability to attacks by secondary fermentations, without having the delicacy of flavor which characterizes the latter. Though unsuited to be used alone, a fair wine can be made of it if the grapes are fermented with, say one third of some robust and tannic wine, such as the Tannat or some of the Italian varieties. It ripens much earlier than the latter, and would have to be blended during the after-fermentation. It cannot, however, be recommended for planting in any locality in California where it has yet been tried.

ANALYSES OF MUSTS AND WINES.

CHAUCHÉ NOIR.			Date of Picking	MUST.				WINE.					
				Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—	No. 1227.	Fresno	Aug. 23	28.40	28.62	.34	.59						
	No. 1290.	Cupertino	Oct. 1	25.00		.55							
	No. 1298.	Mission San José	Oct. 5	26.30		.53	.39	10.81	13.27			.32	2.45
1891—	No. 1446.	Tulare	Aug. 26	26.90		.46							
	No. 1557.	Paso Robles	Oct. 6	22.15		.82							
1892—	No. 1652.	Paso Robles	Sept. 13	19.25		1.71							
	No. 1685.*	Mission San José	Sept. 24	24.10		.64		9.70	12.09	.189	.53	.48	3.10
1893—	No. 1795.	Tulare	Aug. 31	22.80	21.38	.68	.60	8.48	10.58		.56		3.80
	No. 1832.	Amador station	Sept. 7	25.00		.68				.362	.67		
	No. 1868.	Paso Robles	Sept. 15	21.95	20.99	.92		8.34	10.42	.112	.45	.56	3.10
	No. 2075.	Mission San José	Nov. 3	29.10		.47		11.62	14.20	.173	.54	.40	3.10
	No. 2109.	Cupertino	Nov. 1	30.90		.65				.307			
1894—	No. 2150.	Tulare	Sept. 17	28.40		.45							

COLOR READINGS.

CHAUCHÉ NOIR.			At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—	No. 1685.*	Mission San José	50.0	1VR	33.3	4VR	16.6	R	17.4	R	14.8	R	14.8	R-1R
1893—	No. 1832.	Amador station	18.9	3R	10.9	(Y)								
	No. 1868.	Paso Robles	17.2	4VR	7.3	1R	5.9	2R	5.6	1R	5.8	3R	4.6	3R
	No. 2075.	Mission San José	26.8	4VR	17.0	R	15.4	R	13.1	R-1R	4.0	(Y)		
	No. 2109.	Cupertino	22.7	4VR										

* Blend of Chauché noir 73% and Tannat 27%.

RECORD OF TREATMENT.

No. 1227. *Chauché noir*, from Fresno. A sample for must analysis was received August 25, 1890, in fair condition—over-mature and some berries dried. The must showed 28.4% of solid contents by spindle and 0.34% of acid.

No. 1290. *Chauché noir*, from Cupertino. A sample for must analysis was received October 3, 1890, in fair condition, quite ripe. The must showed 25.0% of solid contents by spindle and 0.55% of acid.

No. 1298. *Chauché noir*, from Mission San José. Received October 7, 1890, in bad condition—much crushed and moldy. The must showed 26.3% of solid contents by spindle and 0.53% of acid. The grapes were crushed and fermented as white wine. The temperature at crushing was 67°, and the maximum reached, on the third day, was 83°.

The wine was dry on the tenth day and was racked from the lees. At one month the wine was clear, of light schiller color, smooth, with low acid and high alcohol, but the quality quite spoiled by the taste of mold. At six weeks the lees were not well settled, but seemed sound. At two months the wine was racked for the second time, and at three months the lees were examined again and found to contain some filaments, so the wine was pasteurized. It was clear and had improved somewhat. At seven months it was bright, but still showed the effects of the moldy grapes, and had acquired a Sherry taste. It was racked for the fourth time, and at fourteen months was clear and sound, but showed little improvement in taste. At seventeen months it was bottled, but did not keep well.

No. 1446. *Chauché noir*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 26.9% of solid contents by spindle and 0.46% of acid.

No. 1557. *Chauché noir*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition. The bunches were medium sized, well filled; the berries small and mature. The must showed 22.15% of solid contents by spindle and 0.82% of acid.

No. 1652. *Chauché noir*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 19.25% of solid contents by spindle and 1.71% of acid.

No. 1685. *Chauché noir*, from Mission San José. Received September 27, 1892, in good condition. The must showed 24.1% of solid contents by spindle and 0.64% of acid. The grapes were fermented with No. 1686 in the proportion of 149 lbs. of Chauché noir to 54.5 lbs. of Tannat. The temperature of the grapes at crushing was 67°, and the maximum reached on the fourth day was 96°. In four days and a half the wine was dry, and was drawn off.

In one month the wine was nearly clear, and was racked off and taken to the cellar. At three months it was bright, with some flavor and aroma, medium acid and astringency—a drinkable wine, but not of high quality, and slightly bitter. The lees were sound, and two months later the wine was in good condition and still possessed of a faint sweetness. It was racked for the second time, and a month later the lees showed much *S. ellipsoideus* and a few short filaments. The wine remained, however, in good order, and improved. Tastings at eight, ten, and fourteen months showed a gradual improvement, and at the end of that time it was of good quality and very smooth. It was bottled at eighteen months.

No. 1795. *Chauché noir*, from Tulare station. Received August 31, 1893, in bad condition. The bunches were of the usual size, but the berries were larger; they were flavorless and with little color. The must showed 22.8% of solid contents by spindle and 0.68% of acid. There were 205 lbs. crushed. The temperature of the must at crushing was 63°, and the maximum reached, on the fifth day, was 85°.

The wine was taken off the lees at two weeks, and at one month was nearly clear, and was racked again and taken to the cellar. At five months it was clear, but flat and of poor quality, and was racked for the third time. After this the wine deteriorated, and at one year was quite spoiled.

No. 1832. *Chauché noir*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition. Both bunches and berries were very small, and the berries rounder than usual. The must showed 25.0% of solid contents by spindle and 0.68% of acid.

No. 1868. *Chauché noir*, from Paso Robles station. Received September 15, 1893, in good condition. The bunches were of good size, compact; the berries of average size, mature. The must showed 21.9% of solid contents by spindle and 0.92% of acid. There were 88 lbs. crushed at a temperature of 67°. The maximum temperature reached was 86°, on the fourth day. On the fifth day the wine was dry, and was drawn off.

At three weeks the wine was nearly clear, but of poor quality. It was racked and taken to the cellar, and at four months was clear, much improved, but lacking in color and character. At five months it was racked again, and at eight months it had changed little, was sound, but somewhat green. At eleven months the wine was in good order, sound, of fair quality; had deposited no lees, but did not taste mature. At twelve months it was bottled.

No. 2075. *Chauché noir*, from Mission San José. Received November 3, 1893, in good condition. The bunches were small, conico-cylindrical, with a small wing, close; the berries small, oval, firm, and crisp, very sweet, and overripe. The must showed 29.1% of solid contents by spindle and 0.47% of acid. The 95 lbs. crushed were fermented as red wine, started at a temperature of 63°, and reached a maximum of 88° on the third day. On the fifth day the wine was nearly dry, and was drawn off.

At one month, when it was racked and taken to the cellar, the wine was clear, but still a little sweet. At three months it was not quite clear, faintly sweet, with bitter after-taste, but of good flavor. After this it became still more bitter and generally deteriorated.

No. 2109. *Chauché noir*, from Cupertino. A sample for must analysis was received November 3, 1893, in good condition. The bunches were small, conico-cylindrical, well filled; the berries small, oval, pulpy, very ripe, but with good acid. The must showed 30.9% of solid contents by spindle and 0.65% of acid.

DOLCETTO.

Synonyms: Uva d'Aqui; Dolutz nero.

Description.—Vine rather vigorous and very productive, with short-jointed canes and prominent buds; young leaves of an intense vinous red, covered with a light, whitish down; tendrils, petioles, and nerves of leaves reddish; leaves rather large, and wider than long; bunch large, pyramidal, regular, winged, and well filled; berries bluish-black, round, and thin-skinned.

This variety is cultivated in the north of Italy, principally near Alba and Acqui, and especially on the higher slopes of the Alps and the high valleys of the Apennines. It is valued on account of its early ripening and heavy bearing. It makes a light, very smooth wine, which can be consumed early, on account of its quick development. It lacks the asperity which is so characteristic of most of the red wines of northern Italy when they are young, but it never attains the high quality of the Nebbiolo or Bonarda. The Dolcetto is prized also on account of its good color. In this respect, however, it has not retained its reputation in California. It will be a useful grape to plant for smooth, light, quickly maturing wines, where fair quality and large quantity are desired. It is an excellent table-grape, on account of its fine appearance, agreeable flavor, and early ripening, but is not tough enough for long shipments.

ANALYSES OF MUSTS AND WINES.

DOLCETTO.	Date of Picking...	MUST.				WINE.					Body........
		Solid Contents by Spindle..	Sugar by Copper Test....	Acid as Tartaric......	Ash........	Alcohol.		Tannin	Total Acid as Tartaric.		
						By Volume....	By Weight		At Pressing....	At 6 to 8 Months	
1890—No. 1348. Cupertino..	Oct. 13	19.50	......	.80	....	......	......	......	....	....	....
1891—No. 1572. Asti, Sonoma Co....	Oct. 8	*27.45	27.65	.31	.30	10.91	13.36	.210	.62	.44	2.60
1893—No. 2111. Cupertino..	Nov. 5	26.90	......	.58	....	......	......	.259	....	....	....

* Water and tartaric acid were added to the must.

RECORD OF TREATMENT.

No. 1348. *Dolcetto* (Menlo No. 1), from J. T. Doyle, Cupertino. Received October 13, 1890, in fair condition, some of the bunches being moldy. The bunches were of medium size, conico-cylindrical, sometimes winged, not compacted; the berries over average in size, round, reddish-brown in color, with thin skin and soft, rather juicy flesh; peduncle short and green. The grapes resemble the true Dolcetto very closely, except in their lack of color. The must showed 19.5% of solid contents by spindle and 0.80% of acid. No wine was made.

No. 1572. *Dolcetto,* from Asti, Sonoma County. Received October 10, 1891, in fair condition, over-mature, very sweet, and many grapes half dried. The must showed 27.45% of solid contents by spindle and 0.31% of acid. The grapes (119 lbs.) were crushed at a temperature of 61°. On the second day 1.2 gallons of water and 83.5 grams of tartaric acid were added. The maximum temperature of 87° was reached on the fourth day. On the seventh day, when the wine was drawn off, it was nearly dry.

At one month the wine was bright, had light, delicate aroma, full flavor, clean taste, good astringency, and medium acid. It was racked, and at four months the lees showed a little "graisse," but the wine was bright, little changed, and tasted quite sound. A month later it was racked again. It was very smooth and pleasing, full-bodied, and clean-tasting; it was of excellent quality and was maturing quickly. At ten months it was racked again. At sixteen months it retained its good quality, but had not developed much bouquet. At this date it was racked and part put in bottle At twenty-two months, when the rest of the wine was bottled, it had improved and kept perfectly. At three years and three months the bottled wine was bright, of light color, somewhat deficient in bouquet, but very agreeable and smooth—an excellent wine of Burgundy type.

No. 2111. *Dolcetto,* from J. T. Doyle, Cupertino. A sample for must analysis was received November 7, 1893, in good condition. The bunches were large, irregular, conical, compact, shouldered; the berries large, round, pulpy, very sweet, and with a delicate sub-Muscat flavor. It differed from Mas and Pulliat's description of this variety in the compactness of the bunches, the pulpy nature of the berries, and the marked flavor. The must showed 26.9% of solid contents by spindle and 0.58% of acid.

CARIGNANE.

(See Vit. Rept. 1883-85, p. 92; 1885-87, p. 74; 1887-89, p. 171.)

The results obtained with this grape in different localities of California are somewhat discordant. In a few specially suitable localities it has produced a good wine, while in most others the wine is only from fair to poor. The best results have been obtained on well-drained soils in parts of the Santa Clara Valley and the upper Russian River Valley. In moist, rich soils the vines are very much subject to mildew, and require frequent sulphuring. The must generally possesses sufficient sugar and from medium to high acid. The wine is full-bodied, with medium to low astringency. In favorable localities it has sufficient color, but of a somewhat yellowish cast.

At Tulare and Fresno the Carignane is a thrifty, upright grower, a heavy bearer, and does well in fairly strong alkali. The must is rather low in sugar, with fair acid. It makes a good, neutral wine, lacking in color and tannin, but superior to that of Grenache or Cinsaut from the same place.

ANALYSES OF MUSTS AND WINES.

CARIGNANE.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
						By Weight	By Volume		At Pressing	At Six Months		
1890—No. 1251. Fresno	Aug. 25	20.60	19.89	.74	.41	8.91	11.09	.125	.56	.48	2.36	
No. 1335. Cupertino	Oct. 11	21.50		.72								
No. 1409. Mission San José	Oct. 19	24.80		.95	.33	10.16	12.64	.213	.65	.66	3.08	.32
(*a*) Closed vat		24.80		.95	.27	10.63	13.09	.199		.54	2.82	.26
(*b*) With calcium sulphate		24.80		.95	.45	10.44	12.91	.213		.62	3.94	.28
(*c*) With calcium phosphate		24.80		.95	.40	9.78	12.18	.180		.56	3.22	.26
(*d*) With ammonium phosphate		24.80		.95	.39	9.92	12.36	.217		.48	3.82	.22
1891—No. 1447. Tulare	Aug. 26	21.70		.44								
No. 1525. Asti, Sonoma County	Oct. 6	24.40	23.61	.48	.33	10.00	12.54	.240	.57	.48	2.78	
No. 1576. Paso Robles	Oct. 10	19.70	17.44	.67	.35	7.23	9.00	.123	.63	.48	2.60	
1892—No. 1628. Tulare	Sept. 3	21.50	18.89	.59	.38	8.34	10.42	.143	.54	.56	3.30	
No. 1742. Paso Robles	Oct. 11	24.80		.35								
No. 1791. Mission San José	Oct. 21	20.60		.99		8.27	10.36	.209		.78	3.00	
1893—No. 1871. Amador station	Sept. 12	23.30	20.61	.90	.22			.400				
No. 1887. Tulare	Sept. 22	20.60	18.90	.71	.26	7.92	9.90	.070	.56	.53	2.60	
No. 2081. Paso Robles	Nov. 4	25.90	24.12	.51	.34	9.78	12.18	.154	.47	.48	3.30	
1894—No. 2173. Amador station	Sept. 24	22.60		.68								
No. 2210. Tulare	Sept. 27	22.20	21.22	.47		8.34	10.42	.146	.53	.44	2.60	
No. 2223. Amador station	Oct. 3	25.40		.53								
No. 2295. Mission San José	Oct. 12	20.20		.85								

COLOR READINGS.

CARIGNANE		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.	
1891—No. 1525.	Asti, Sonoma County	44.0	2VR	28.6	3VR	21.7	4VR	15.4	1R	14.2	1R
No. 1576.	Paso Robles	33.3	3VR	14.4	4VR	7.6	R-1R	6.3	1R	.....	.....
1892—No. 1628.	Tulare	13.3	4-5VR	7.4	3VR+Y	7.0	4VR+Y	6.0	R+Y	5.3	1R+Y
No. 1791.*	Mission San José	97.5	1VR	43.0	1VR	38.8	2VR	29.2	3VR	28.2	3VR
1893—No. 1871.	Amador station	71.4	4VR	55.5	1VR	.....	.....	.....	.....	.....	.....
No. 1887.	Tulare	11.1	3VR	6.2	VR+Y	3.3	(YY)	.....	.....	.....	.....
No. 2081.	Paso Robles	32.0	1VR	25.0	2VR	23.6	5VR	22.7	5VR	.....	.....
1894—No. 2210.	Tulare	12.9	R	5.3	3R	6.2	2R	6.2	3R	.....	.....

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* Blend of Carignane and Robin noir.

RECORD OF TREATMENT.

No. 1251. *Carignane*, from Margherita Vineyard, Fresno. Received August 25, 1890, in good condition; bunches and berries very large, taste insipid, and watery. The must showed 20.6% of solid contents by spindle. The temperature of the grapes at crushing was 70°, and the maximum reached was 78°. The fermentation was very slow, and the must remained at about 78° for three or four days. On the seventh day the murk was drawn off when still sweet.

Six days after pressing the wine was dry, and in three weeks more clear. At two months it was bright, sound, very rough, and with little flavor. It was racked twice during the first seven months, and remained bright, becoming smoother, and at the end of that time was pleasant, but somewhat insipid. At seventeen months it was in good condition, with little color, some bouquet, neutral flavor, and full acid. Two months later it was mature, and some of it was bottled. At twenty-seven months the remainder was bottled. At three years both bottlings were sound, but flat and of poor quality.

No. 1335. *Carignane*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 13, 1890, in good condition, and mature. The must showed 21.5% of solid contents by spindle.

No. 1409. *Carignane*, from Mission San José. Received October 20, 1890, in fair condition, very soft and a few bunches moldy. The must showed 24.8% of solid contents by spindle. The grapes were used for a series of experimental fermentations, for the results of which see "Fermentations with various substances" (Part II of this report).

No. 1447. *Carignane*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 21.7% of solid contents by spindle.

No. 1525. *Carignane*, from Asti, Sonoma County. Received October 8, 1891, in good condition, and mature. The must showed 24.4% of solid contents by spindle. The temperature of the must at crushing was 66°, and the maximum of 81° was reached on the sixth day. On the ninth day the murk was drawn off while still a little sweet.

One month from pressing the wine was bright, quite dry, very rough, and with a burnt taste. At five months the wine had been racked twice, and was bright, vinous, with good body and some bouquet, generally much improved. It continued to improve and at sixteen months had developed into an excellent wine. Some of the wine was bottled at sixteen months, and some at twenty-two months. At three and a half years the wine last bottled was bright, with good color, marked bouquet, and full flavor, generally an excellent, clean-tasting wine, a little too astringent, but full and round. There was a little well-settled deposit in the bottles. The wine first bottled tasted undeveloped and had made a heavy deposit.

No. 1576. *Carignane*, from Paso Robles station. Received October 12, 1891, in good condition, but not mature; the grapes were very small. The must showed 19.7% of solid contents by spindle. The temperature of the grapes at crushing was 64°, and the maximum reached was 82°, on the third day. The murk was nearly dry on the third day, and was drawn off on the fourth.

At one month from pressing the wine was nearly clear, but coarse and not pleasing. At six months it had been racked twice, and was bright, had developed some bouquet, and was much improved, though still rough. It was racked twice after this, and remained bright, but did not improve much. At fifteen months it was bottled. The wine developed too quickly, owing to smallness of sample, and, though it kept in good order in bottle, did not develop its best qualities.

No. 1628. *Carignane*, from Tulare station. Received September 6, 1892, in good condition, and mature. The must showed 21.5% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum reached was 87°, on the fourth day. The murk was dry on the fifth day, when it was drawn off.

A month after pressing the wine was clear, and was racked and taken to the cellar. At four months it was bright, fresh, smooth, and pleasing, but with little flavor. It was racked three times during the first year, and remained in good condition; was a good, clean-tasting, neutral wine, with little character. At fifteen months it was nearly mature, and was one of the best of the Tulare wines; the color was very deficient. At twenty-two months it was bottled. One year after bottling it was bright, with some bouquet and flavor, full acid for a Tulare wine—a good wine, but lacking in character, solidity, and color, yet superior to many of the Tulare wines.

No. 1742. *Carignane*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 24.8% of solid contents by spindle.

No. 1791. *Carignane*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 20.6% of solid contents by spindle. This variety was fermented with No. 1792, Robin noir, from the same locality, about equal parts of each being used. The temperature of the grapes at crushing was 63°, and the maximum reached was 88°, on the third day. The murk was drawn off on the fourth day, when nearly mature.

A month after pressing the wine was nearly clear. At three months it was bright, rough and coarse, but sound and of good body. It was racked three times during the first year, remained in good order, and gradually improved, losing its harshness. At fourteen months it was nearly mature, and at eighteen months was bottled.

No. 1871. *Carignane*, from Amador station. A sample for must analysis and for acid and tannin tests was received September 14, 1893, in good condition. The bunches were large, the berries small and well colored. The must showed 23.3% of solid contents by spindle.

No. 1887. *Carignane*, from Tulare station. Received September 22, 1893, in good condition. The bunches were large and compact; the berries large and mature, but not well colored or very sweet. The ripening was irregular, some of the bunches had dried berries, and some had berries still uncolored. This was due to the fact that some of the vines had grown in strong alkali ground, where they produced scantier foliage, and thus allowed the grapes to ripen earlier. The must showed 20.6% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the maximum reached was 92°, on the third day. On the fourth day the murk was dry, and was drawn off.

In three weeks the wine was clear. At five months the wine had been racked twice, was bright and pleasing. At eight months it was sound, but flat and without much character or color.

No. 2081. *Carignane*, from Paso Robles station. Received November 4, 1893, in fair condition. The bunches were large, close, irregular, and heavily shouldered; the berries large, thick-skinned, very sweet, and commencing to dry. The must showed 25.9% of solid contents by spindle. The temperature of the grapes at crushing was 62°, and the maximum reached was 92°, on the third day. The murk was drawn off on the fifth day, while still sweet.

In one month the wine was still sweet, but clear. In two months it was bright, of good flavor and aroma, medium acid, and good body and astringency, still slightly subsweet. At six months it had been racked twice, and was of good quality, but not quite clean-tasting.

MATARO.

(See Vit. Rept. 1887-89, p. 192.)

This variety has been rather extensively planted, but, unfortunately, principally in the cooler parts of the coast valleys, to which it is least suited. At Mission San José, in the cooler parts of the Santa Clara Valley, in San Mateo County, and the lower parts of the valleys of Sonoma and Napa, it has been well tested, and though it generally yields good crops it is too late and gives a very harsh, low-bodied, common wine, is often deficient in sugar, and seldom ripens before the autumn rains begin. In the warmest localities of the Santa Clara Valley, in the Livermore Valley, and at the Asti Vineyard in the warm Cloverdale Valley, it has done better, bearing good crops, making a sound, solid, somewhat coarse wine, good for blending purposes in the production of ordinary wines. It seems, however, more adapted to the southern parts of the State; it has given excellent results in Los Angeles and San Diego counties. At Fresno and Tulare the vine lacks sufficient foliage, rendering the grapes subject to sunburn. At the Amador foothill station the grapes run low in acid, and give a wine that tends to the Port type. At Paso Robles the wine is lacking in color, tannin, and body, but as the vines are young these faults may decrease.

The average of seven analyses of this variety from the Bay region is 20.7% of sugar and 0.70% of acid; the body and tannin are very low for this same region. The average of four analyses of grapes from Amador station is 24.6% of sugar and 0.37% of acid, showing enough sugar but low acid. At Fresno the composition of the must has been fairly satisfactory, but at Tulare it has been very low in acid.

ANALYSES OF MUSTS AND WINES.

MATARO.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1252.	Fresno	Aug. 25	21.30	20.24	.53	.42	8.48	10.58	.104	.50	.43	2.32
No. 1255.	Amador County; G. A. Danet	Sept. 18	22.40	......	.41	.40	9.20	11.45	.156	.63	.50	2.58
1891—No. 1574.	Asti, Sonoma County	Oct. 7	23.05	22.67	.56	.36	9.70	12.09	.129	.55	.44	2.35
No. 1596.	Asti, Sonoma County	Oct. 18	25.00	23.04	.50	.31	10.81	13.27	.236	.93	.82	3.35
No. 1609.	Mountain View	Oct. 30	20.70	20.24	.78	.32	8.62	10.75	.143	.78	.52	2.55
No. 1610.	San José; Dr. Dudley	Nov. 1	22.08	21.80	.77	.40	9.20	11.45	.162	.74	.55	2.45
No. 1611.	Mountain View	Nov. 2	21.50	20.99	.70	......	9.20	11.45	.255	.71	.39	2.55
1892—No. 1727.	Paso Robles	Oct. 10	21.95	......	.47	......	......	......	......	......	......	......
1893—No. 1921.	Paso Robles	Oct. 12	22.60	20.99	.60	.23	8.13	10.17	.070	.58	.42	2.30
1894—No. 2172.	Amador station	Sept. 24	26.00	......	.33	......	......	......	......	......	......	......
No. 2313.	Tulare	Oct. 15	23.00	......	.28	......	......	......	......	......	......	......

COLOR READINGS.

MATARO.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.	
1891—No. 1574.	Asti, Sonoma County	24.4	4VR	15.5	5VR	7.8	1VR+Y	6.8	2VR+Y	......	......
No. 1596.	Asti, Sonoma County	125.0	2VR	70.0	5VR	48.6	4VR	47.6	5VR	32.5	5VR
No. 1596a.	Asti, Sonoma County	143.0	1VR	63.5	4VR	55.5	3VR	47.0	4VR	35.7	4VR
No. 1609.	Mountain View, San Mateo County	51.2	2VR								

RECORD OF TREATMENT.

No. 1252. *Mataro*, from Margherita Vineyard, Fresno. Received August 27, 1890, in good condition. The bunches were large, the grapes large and mature. The must showed 21.3% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the maximum reached was 79°, on the fourth day. On the seventh day the murk was nearly dry, and was drawn off.

The wine was quite dry one week after pressing, but was some time in clearing. At two months it was bright, with light aroma, pleasing flavor, full acid, and medium astringency, very little color, neutral but agreeable. It was racked at one, three, and five months. The lees showed some *S. pastorianus* at four months. At eight months it was bright, and had improved; it possessed more character than No. 1251, Carignane. At seventeen months it was in good condition, and mature; it had lost almost all its color, and was neutral, with little bouquet, but clean taste. The wine was bottled, part at nineteen and part at twenty-nine months. At three years the wine first bottled was clear, sound, clean-tasting, lacking in delicacy; the second bottled was much inferior to the other, and had not kept well.

No. 1255, *Mataro*, from G. A. Danet, Amador County. These grapes were taken from six-year-old vines grown nearly on a hilltop, and well cultivated. Received September 20, 1890, in poor condition—loosely packed and much crushed. The bunches were of medium size and well filled. Many of the grapes were sunburnt. The must showed 22.4% of solid contents by spindle. The temperature of the grapes at crushing was 65°, and the maximum reached was 75°, on the fifth day. The fermentation was very sluggish, and the murk was drawn off on the seventh day while it was still sweet and fermenting.

In two weeks after pressing the wine was quite dry, but still cloudy. At two months it was clear and of marked and pleasing, but somewhat coarse, flavor and aroma, medium acid, good astringency and body. An examination of the lees at three months showed the presence of much *S. pastorianus*. At this date the wine was rough, but bright and sound, and was racked for the second time. After this it lost a little of its roughness, but though sound and agreeable was far from delicate. At fifteen months it was in good order and nearly mature. At sixteen months it was bottled. At three years the bottled wine was tasted, and found to be perfectly sound and in good order, clean-tasting and agreeable, but with little character; no deposit had been formed in the bottle.

No. 1574. *Mataro*, from Asti, Sonoma County. Received October 10, 1891, in good condition but for a little mold. The must showed 23.05% of solid contents by spindle. The temperature of the grapes at crushing was 61°, and the maximum reached was 82°. The murk was still a little sweet when drawn off on the seventh day.

The wine was nearly clear in five weeks, was without aroma, with little flavor, smooth, rather flat. In four months it was bright and somewhat improved, but its after-taste was not good. A month later it was in good order and a little improved, but without much character. After the second racking at ten months it continued to improve, and at sixteen months was smooth and well flavored. At eighteen months part of the wine was bottled. The part that was left in the cask deteriorated and acquired a bitter flavor. The remainder was bottled at twenty-two months. At three years and a half the bottled wine was tasted; it was bright, light in color, with some bouquet and flavor—a good, sound wine, not of high quality, but pleasing.

No. 1596. *Mataro*, from Asti, Sonoma County. Received October 21, 1891, in good condition. The grapes were mature and a few of them dried. The must showed 25.0% of solid contents by spindle. The grapes were divided into two parts of equal size; one part was fermented in the ordinary way, and the other was fermented according to Mr. Barth's system of close fermentation. The record of the ordinary fermentation is as follows: The temperature of the grapes at crushing was 67°, and the maximum reached was 80°, on the third day. The murk was still sweet on the fifth day, when it was drawn off.

In four days after pressing the wine was dry. It was somewhat slow in clearing. At five months it was bright, a coarse wine, tasting strongly of the stems. It was racked three times during the first fourteen months, and kept in good order. It remained sound and developed a little bouquet, but remained coarse, though a little smoother with age. It was bottled, part at eighteen months and part at twenty-two months. At three and one half years the bottled wine was bright, of good color, a little bouquet and flavor—a full, sound wine, with rather harsh acid, generally somewhat coarse, but good for blending. The later bottling was the better. No difference was perceptible in the wine fermented by Mr. Barth's process.

No. 1609. *Mataro*, from Mountain View, Santa Clara County. Received October 31, 1891, in poor condition. The must showed 20.7% of solid contents by spindle. The grapes were fermented with half the stems. The temperature of the grapes at crushing was 67°, and the maximum reached was 90°, on the third day. The murk was drawn off on the fourth day while still a little sweet, but on the sixth day was quite dry.

The wine was a little slow in clearing, but in two months was bright, sound, of good flavor, little aroma—good, but with little character. One month after the first racking the lees showed a few filaments, but as the wine tasted quite sound it was not pasteurized. At four months it was quite sound and had improved greatly, was a very fair, neutral wine. It was racked three times during the first year, and at fifteen months was smooth, pleasing, and mature. It kept well after this, but developed very little bouquet. At twenty-one months it was bottled. At three and one half years the bottled wine was sound and good, with little character or color, but smooth and agreeable.

No. 1610. *Mataro*, from Dr. Dudley, San José. Received November 4, 1891, in fair condition—bruised, but with only a very little mold. The must showed 22.08% of solid contents by spindle. The grapes were divided into two parts: (1) for white wine, 361 lbs. were crushed, pressed, and fermented as white wine; (2) for red wine, 488 lbs. were crushed and fermented on the skins, together with two and a half gallons of juice from that pressed for white wine. The fermentation of the red wine was cool, and a little slow; the temperature of the grapes at crushing was 67°, and the maximum reached was 87°, on the third day. On the sixth day, while the murk was still a little sweet, it was drawn off. The white wine commenced at the same temperature, and fermented slowly for nearly a month, at the end of which time it was dry. The maximum temperature reached was 76°, on the third day.

Mataro (white). At the end of six weeks the wine was clear, dry, schiller, very acid, and raw. It was racked five times during the first year, and remained bright and sound, but coarse. At the end of fifteen months it had lost its schiller tint, and was in good condition; it was, however, very coarse and rough, and generally not a success as a white wine. At seventeen months it was racked, and a portion put in glass. At three and a half years the bottled wine was bright, without deposit, a good neutral wine, with little character, but smooth and agreeable; would have been useful as a neutral blend.

Mataro (red). Two weeks after pressing, the wine was nearly clear and quite dry. At one month it was bright, very rough, and somewhat coarse. The wine was of good color, remained bright, and developed well, though slowly. At the end of a year it was in good condition, had been racked three times, and tasted sound, though the lees showed a little "graisse." The wine matured slowly, remained fresh and agreeable, and developed a slight but not unpleasant bitterness. It was racked three times during the second year, at the end of which some of it was bottled, though it did not taste quite mature. At the end of thirty-three months it was racked again, and another portion put in glass. At three and a half years the later bottling was bright, good, and sound, with little bouquet or flavor—a common but drinkable wine; the earlier bottling had more color and flavor, but was not so clean-tasting.

No. 1611. *Mataro*, from Mountain View. Received November 5, 1891, in good condition, wet by the rain. The must showed 21.5% of solid contents by spindle. The grapes were divided into two equal parts, one of which was fermented in the ordinary way with the addition of the stems, and the other according to Mr. Barth's method of close fermentation, also with the addition of the stems. The ordinary fermentation commenced at a temperature of 66°, and reached its maximum temperature of 87° on the third day. It was drawn off on the fourth day, when nearly dry. The close fermentation commenced at the same temperature of 66°, and reached a maximum of 82° on the second day. It was drawn off on the seventh day, while still a little sweet.

Mataro (*b*) (ordinary fermentation). At three weeks the wine was still cloudy and with a trace of sugar, perhaps a little more than No. 1611*a*. At six weeks it was racked, when it was clear, and little if at all distinguished from No. 1611*a*. Soon after this the lees showed a little lactic and the taste was slightly affected. At nine weeks it was pasteurized. At four months it was in good condition, a rough, strong wine, sound but with little flavor or aroma, and of mediocre quality. It was racked twice after this before it was fifteen months old, when it was in good condition, much toned down, and of rather good quality, but with little distinctive character. Part of it was bottled at this age. At twenty-one months it had changed very little, and was indistinguishable from No. 1611*a*. The remainder was bottled at this date. At three and one half years the bottled wines were tasted. The earlier bottling of the ordinary fermentation was the best; bright, with little deposit—a good wine, but not of high quality. The close fermented wine, bottled at the same time, had deposited heavily and was not as clean-tasting, showing a slower development. The later bottlings of each sample showed little difference.

Mataro (*a*) (closed fermentation). At three weeks the wine was still cloudy, and contained a trace of sugar. At six weeks it was clear, of good flavor, but without aroma, still slightly sweet. At six weeks it was in good condition and had a little bouquet, and though the lees showed a few filaments, the taste was unaffected. It was pasteurized for safety. After this the record is the same as for No. 1611*b*, except that at first it had a little more bouquet. At twenty-one months both wines were practically identical, as far as the taste went.

No. 1727. *Mataro*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The grapes were very small. The must showed 21.95% of solid contents by spindle.

No. 1921. *Mataro*, from Paso Robles station. Received October 12, 1893, in good condition. The bunches were small, rather compact; the berries small, sweet, quite mature. The must showed 22.6% of solid contents by spindle. The temperature of the grapes at crushing was 69°, and the fermentation lasted five days, at the end of which time the murk was drawn off dry.

In three weeks the wine was nearly clear, showed high acid and low astringency. It was racked twice during the first two months, when it was clear and smoother, but lacking in color. The quantity was too small to keep well, and after this the wine deteriorated. At seven months it was much inferior to the Grenache from the same locality.

MOURASTEL.

(See Vit. Rept. 1883–85, p. 106; 1887–89, p. 197.)

This variety has fully maintained its European reputation as a heavy bearer. It is a strong grower and bears well almost everywhere, and in some places, such as Tulare and Fresno, it bears immense crops. It ripens late, but somewhat earlier than the Mataro. At Mission San José it gives a good neutral wine, excellent for blending, but thin. At first it has good color, but the color is very unstable and is quickly dropped. The average of five analyses gave 21.9% of sugar and 0.78% of acid. At Cupertino the average of five analyses was 22.9% of sugar and 0.76% of acid.

At Tulare the vine is a good grower and produces very fine, large, and sound grapes; the must has averaged 21.3% of sugar and 0.61% of acid, and ferments well. It produces a sound neutral wine, very similar to that of the Carignane of the same locality and with the same defects, viz., almost total lack of color, and low tannin.

At Paso Robles the grapes attain more sugar and sufficient acid. The variety is promising for this locality, though the color is somewhat at fault. The must has from medium to high percentages of acid in all localities, and is a good fermenter.

ANALYSES OF MUSTS AND WINES.

MOURASTEL.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1326. Cupertino	Oct. 11	18.40		1.37	.31	7.57	9.45	.099	.81	.62	2.32
No. 1330. Mission San José	Oct. 11	21.50		.99	.24	8.62	10.75	.191	.78	.52	2.75
1891—No. 1439. Tulare	Aug. 24	19.70		.64							
No. 1471. Fresno	Aug. 28	20.85	19.89	.80	.65	8.13	10.17	.168	.63	.53	2.70
No. 1528. Paso Robles	Oct. 5	20.60	20.24	.62	.34						
No. 1569. Mission San José	Oct. 6	21.70		.90		8.77	10.91	.152	.88	.52	2.75
1892—No. 1690. Tulare	Sept. 26	21.50	21.38	.41	.33	8.55	10.67	.143	.48	.50	2.80
No. 1759. Paso Robles	Oct. 11	23.70		.46							
1893—No. 1863. Amador station	Sept. 13	21.10		1.03							
No. 1898. Tulare	Sept. 28	22.00	20.99	.71	.33	8.13	10.17	.087	.69	.47	2.45
No. 2045. Cupertino	Nov. 1	24.35		.86				.234	.93		
No. 2071. Paso Robles	Nov. 3	24.25	23.91	.50	.33	9.56	11.91	.166	.63	.45	2.80
No. 2074. Mission San José	Nov. 3	22.10	20.99	.83	.23	8.48	10.58	.163	.78	.53	2.30
1894—No. 2176. Amador station	Sept. 24	24.40		.49							
No. 2278. Tulare	Oct. 5	22.60	21.38	.50				.139	.55	.45	2.60
No. 2343. Mission San José	Oct. 24	20.40		.57				.133	.58		

COLOR READINGS.

MOURASTEL.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.	
1891—No. 1471. Fresno	9.6	R	5.5	2R	4.1	4VR+Y				
No. 1569. Mission San José	111.1	1VR	24.0	1R						
1892—No. 1690. Tulare	14.2	5VR	9.5	1VR+Y	5.5	2R+Y				
1893—No. 1898. Tulare	11.7	5VR	4.2	5VR+Y						
No. 2045. Cupertino	56.3	VR								
No. 2071. Paso Robles	30.8	3VR	15.4	R	10.4	R	10.5	5VR	9.3	R
No. 2074. Mission San José	70.2	3VR	52.0	2VR	52.7	2VR	44.9	1-2VR	26.3	3VR
1894—No. 2278. Tulare	11.5	2R	6.0	1R	5.2	3R+Y				

RECORD OF TREATMENT.

No. 1326. *Mourastel,* from Cupertino. Received October 13, 1890, in fair condition, but not mature. The must showed 18.4% of solid contents by spindle. The temperature of the crushed grapes was 65°, and the maximum reached was 92°, on the fourth day. The murk was still a little sweet on the fifth day, and was drawn off on the sixth.

Three weeks after pressing the wine was nearly clear, very acid, and light in color. At three months it was racked for the second time; the lees showed much *S. pastorianus;* the wine was quite bright, of good bouquet and flavor, high acid, medium body and astringency, vinous, and clean-tasting; it was of fairly good quality, but thin and green, and after six months deteriorated rapidly. In a year it had lost nearly all its color and quality.

No. 1330. *Mourastel,* from Mission San José. Received October 14, 1890, in good condition, and mature. The must showed 21.5% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum reached was 96°, on the fourth day, when, being nearly dry, the murk was drawn off.

The wine was somewhat slow in clearing, but in two months was clear and of fair quality; it had very little aroma and a neutral flavor, full acid, and medium astringency. It developed well, and at six months had improved much, the bouquet and flavor were marked and pleasing, the acid a little high. The lees showed a good deal of *S. pastorianus.* At fifteen months the wine was in good order, very fresh and pleasing, but not quite mature. At sixteen months part of the wine was bottled, and the rest bottled at twenty-six months. At thirty-nine months both wines were tasted; the first bottling had not kept well, but the second was in first-class order, with good flavor and bouquet, a smooth and agreeable wine.

No. 1439. *Mourastel,* from Tulare station. Received August 27, 1891, in good condition. The must showed 19.7% of solid contents by spindle. Only a small sample for must analysis was received.

No. 1471. *Mourastel,* from Margherita Vineyard, Fresno. Received September 1, 1891, in good condition. The must showed 20.85% of solid contents by spindle. The temperature of the grapes at crushing was 70°, and the maximum reached was 84°, on the fourth day. The fermentation was slow and the murk was still sweet when it was drawn off on the seventh day.

In two weeks the wine was nearly, and in six weeks quite, dry and clear; it was clean-tasting, with full acid and astringency, but little flavor or aroma. At four months the lees showed a little acetic ferment and some *S. pastorianus;* the wine was clear, clean-tasting, with little character, and showed signs of maturing quickly. It soon became bright and continued to improve up to seventeen months, becoming a light and agreeable wine, but lacking in quality and vinosity. Part of the wine was bottled at nineteen months, after which the rest, which was left in wood, deteriorated. More of the wine was bottled at twenty-three months. At three and one half years the wine of both bottlings was bright and very much improved, lacking in color and character, but good and clean-tasting, with no deposit, and perfectly mature; a good, neutral, blending wine. Some wine bottled at twelve months was spoiled.

No. 1528. *Mourastel,* from Paso Robles station. Received October 7, 1891, in good condition. The must showed 20.6% of solid contents by spindle. The grapes were fermented with No. 1527, Grenache.

No. 1569. *Mourastel,* from Mission San José. Received October 9, 1891, in good condition, but somewhat sunburnt. The must showed 21.7% of solid contents by spindle. The temperature of the must at crushing was 60°, and the maximum reached was 87°, on the fourth day. The murk was nearly dry on the fifth day, when it was drawn off.

At one month the wine was clear and showed good acid and astringency. At four months the lees showed a little "graisse," but the wine was bright, of good flavor, with some bouquet and generally much improved. At five months it was in good order and maturing well; it showed full acid and increased bouquet. A month later the lees were examined, and showed much *S. pastorianus.* At sixteen months it was good, clean-tasting, and mature. At this age part was bottled and the rest left in wood, where it kept perfectly and was bottled at twenty-two months. At three and a half years the later bottled wine was bright, light in color, without bouquet and with little flavor, high acid, a clean-tasting wine, but lacking character; the earlier bottled had rather more color and flavor.

No. 1690. *Mourastel,* from Tulare station. Received September 29, 1892, in good condition. The must showed 21.5% of solid contents by spindle. The temperature of the must at crushing was 69°, and the maximum reached was 87°, on the third day. The murk was still a little sweet on the fourth day, and was drawn off on the fifth.

In one month after crushing the wine was nearly clear and quite dry. At three months it was bright, of good flavor, full astringency, somewhat coarse, but sound and good. After this the wine remained in good order and became smoother, but did not develop any bouquet. At fourteen months it was quite sound and nearly mature, but had lost nearly all its color. At eighteen months it was bottled.

No. 1759. *Mourastel,* from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 23.7% of solid contents by spindle.

No. 1863. *Mourastel,* from Amador station. A sample for must analysis was received September 15, 1893, in poor condition; the grapes were very small, diseased, and not ripe.

No. 1898. *Mourastel*, from Tulare station. Received September 28, 1893, in good condition. The bunches were very large, irregular, and compact; the berries large, sound, and very fine in appearance, with thick skins, but little color. The must showed 22.0% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum reached was 94°, on the fourth day. The murk was dry on the fifth day, when it was drawn off.

The wine was a little slow in clearing. A month after pressing it was nearly clear, clean-tasting, but without flavor or color. At five months it was clear, clean-tasting, with medium acid and astringency, little character, altogether a fairly drinkable wine. Being in a sixty-gallon keg it was much less advanced than other wines in smaller quantities. At this age it was racked into two twenty-five-gallon kegs. At nine months it was in good order, improved in flavor, and quite sound.

No. 2045. *Mourastel*, from J. T. Doyle, Cupertino. A sample for must analysis and for color and tannin tests was received October 31, 1893, in good condition. The bunches were over medium in size, irregular, short-conical, close; the berries over medium in size, pulpy, soft, mature, with little flavor. The must showed 24.35% of solid contents by spindle.

No. 2071. *Mourastel*, from Paso Robles station. Received November 3, 1893, in fair condition. The bunches were of medium size, conical, shouldered, compact; the berries over medium in size, round, thick-skinned, soft, overripe. The must showed 24.25% of solid contents by spindle. The temperature of the must at crushing was 62°, and the maximum reached was 80°, on the fourth day. The murk was dry on the sixth day, when it was drawn off.

In one month from pressing the wine was clear. In two months it was clear, rough, and astringent, with medium acid, good body, and coarse flavor. At six months it had been racked twice, and was much improved, still rough, but clean-tasting, and with good keeping qualities. At nine months it had changed little and still showed a trace of sugar, though quite sound. An examination of the lees showed the presence of *S. pastorianus*.

No. 2074. *Mourastel*, from Mission San José. Received November 3, 1893, in good condition. The bunches were over medium in size, conical, shouldered, compact; the berries of medium size, soft, thick-skinned, mature. The must showed 22.1% of solid contents by spindle. The temperature of the grapes at crushing was 61°, and the maximum reached was 89°, on the third day. The murk was dry on the fourth day, when it was drawn off.

The wine was clear within one month after pressing, and was racked twice during the first three months. At six months it was bright, with little bouquet, good flavor, medium astringency, full acid, clean taste—a good wine, but not of high quality. At nine months it was sound and in good order.

BECLAN.

(See Vit. Rept. 1883-85, p. 91; 1886, p. 73.)

For certain soils and locations this variety is more valuable than its limited distribution would seem to indicate. It is especially adapted to cooler localities and to fairly strong soils. Under these conditions it bears about three tons to the acre with short-pruning, shades its grapes sufficiently, and is very free from disease. In warmer localities or lighter soils it is less vigorous and deficient in foliage, rendering its grapes liable to sunburn. The bunches are regular, of medium size, long conico-cylindrical, with small shoulders and often a small wing, compact but not so much so as to press the berries out of shape or prevent the free circulation of air; the berries are under medium size, round, crisp, juicy, thick-skinned and not easily injured, and with a fresh and agreeable taste.

The grapes ripen earlier than the Cabernets, and a little later than the Pinots, attaining a good percentage of sugar (23% to 25%) with medium acid (0.40% to 0.50%). These figures refer to results obtained at Mission San José and Paso Robles. In warmer places, such as Tulare, the must is deficient in acid. In the rich soil of Tulare the vine grows vigorously where the alkali is not too strong, but does not bear well. The must from grapes grown at Mission San José ferments somewhat slowly but thoroughly, and makes a very good wine, of medium acid and tannin, sufficient color and clean taste. It requires, however, the addition of some Cabernet or similar grape, as, when alone, it lacks character. It has, in fact, a peculiar taste when pure, which is hardly agreeable, but which disappears with proper blending.

ANALYSES OF MUSTS AND WINES.

BECLAN.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
1893—No. 1927. Paso Robles	Oct. 12	23.25	22.04	.50	.25	......	......	.259	.47	......	......
No. 1967. Tulare	Oct. 16	24.80	23.42	.23	.36	9.20	11.48	.138	.42	.44	3.20
1894—No. 2273. Mission San José	Oct. 3	23.70	22.90	.45	......	......	......	......	.47	......	......
No. 2314. Tulare	Oct. 13	24.50	......	.33	......	......	......	......	......	......	......

COLOR READINGS.

BECLAN.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1893—No. 1927. Paso Robles	54.8	VR	26.1	3VR	......	......	......	......	......	......	......	......
No. 1967. Tulare	36.7	VR	29.6	1VR	19.5	3VR	17.1	5VR	6.2	(Y)	5.0	(Y)
1894—No. 2273. Mission San José	70.8	1VR	60,6	1VR	49.4	1VR	19.0	4VR	......	......	......	......
No. 2273a. Mission San José	30.5	VR	23.1	VR	16.0	1VR	12.1	4VR	......	......	......	......

RECORD OF TREATMENT.

No. 1927. *Beclan*, from Paso Robles station. A sample for must analysis and for tannin and color tests was received October 12, 1893, in good condition. The bunches were small, narrow, cylindrical, very regular, and compact; the berries very small, round, juicy, somewhat shriveled, but with good acid. The must showed 23.25% of solid contents by spindle.

No. 1967. *Beclan*, from Tulare station. Received October 16, 1893, in good condition. The bunches were small, cylindrical, and close; the berries round, small, very sweet, and some of them dried. The must showed 23.42% of solid contents by spindle. The initial temperature of the must was 68°, and the maximum of 83° was reached on the third day. The fermentation was over on the fifth day.

In one month the wine was clear, clean-tasting, and of good flavor. At three months it was bright, smooth, and agreeable. At six months it retained its good quality, but was lacking in color.

PETIT BOUSCHET.

(See Vit. Rept. 1883-85, p. 109; 1887-89, p. 226.)

As a variety for the production of cutting wines at the Bay region stations this variety seems to be inferior to the Alicante Bouschet in everything but bearing and body. The average composition of the must at these stations has been: Sugar, 21.3%; acid, 0.77%; tannin, 0.414%, and body, 3.31%. This would indicate a wine excellent to blend with such a wine as that of the Beclan, which has flavor, delicacy, and full alcohol, but is lacking in color, tannin, and robustness. But for general purposes the Alicante would be preferable.

At Tulare the vines of this variety are growing in a somewhat alkaline, sandy soil; they are strong growers, with good foliage and are heavy bearers. From six to twelve tons per acre have been obtained, of very sound, well-ripened grapes. The must is rather low in sugar, but has sufficient acid. It has always fermented well and made a good, sound wine, not of high quality, but good for blending purposes. The wine has had sufficient color for itself, but not enough to be of use to blend with a wine lacking in color. In this respect it has fallen below Gros Mansenc, St. Macaire, and Barbera, and has been equaled by Refosco and Charbono. The wine is somewhat richer in tannin than that of Barbera, but falls below that of Refosco.

ANALYSES OF MUSTS AND WINES.

PETIT BOUSCHET.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1245.	Fresno	Aug. 24	24.70	25.76	.51	.41	------	------	------	------	------	------
No. 1378.	Mission San José	Oct. 18	23.50	------	.80	.39	9.12	11.36	.485	.83	.37	3.32
No. 1394.	Cupertino	Oct. 18	23.70	------	.69	------	------	------	------	------	------	------
1891—No. 1435.	Tulare	Aug. 24	22.20	22.05	.53	.50	8.84	11.00	.227	.43	.45	3.12
No. 1529.	Paso Robles	Oct. 5	20.05	------	.51	.45	------	------	------	------	------	------
1892—No. 1627.	Tulare	Sept. 3	22.20	21.38	.57	.45	8.41	11.09	.185	.58	.50	3.05
No. 1745.	Paso Robles	Oct. 11	20.40	------	.51	------	------	------	------	------	------	------
No. 1778.	Mission San José	Oct. 13	21.60	21.80	.92	------	------	------	------	------	------	------
1893—No. 1882.	Tulare	Sept. 15	21.20	19.54	.65	.32	8.07	10.03	.221	.48	.52	2.85
No. 2009.	Paso Robles	Oct. 26	24.80	24.12	.47	.29	9.56	11.91	.480	.48	.47	3.10
No. 2048.	Cupertino	Nov. 1	20.40	------	.80	------	------	------	.473	------	------	------
No. 2120.	Cupertino	Nov. 7	18.60	------	.84	------	------	------	.502	------	------	------
1894—No. 2168.	Tulare	Sept. 20	22.30	21.80	.43	------	8.48	10.58	.298	.55	.35	2.85
No. 2226.	Mission San José	Oct. 4	19.70	19.21	.73	------	6.42	8.07	.266	.77	.62	3.30
No. 2293.	Mission San José	Oct. 12	21.50	------	.58	------	7.64	9.54	.345	------	.49	3.50

COLOR READINGS.

PETIT BOUSCHET.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1891—No. 1435.	Tulare	15.5	2R	11.6	3VR+Y	7.1	1R+Y	6.4	1R+Y	7.1	2R+Y	8.3	3R+Y	------	------
1892—No. 1627.	Tulare	38.4	4VR	21.5	5VR	12.9	1R	11.4	1R	11.8	2R	11.4	2R	11.4	2R
1893—No. 1882.	Tulare	57.1	2VR	37.0	5VR	20.6	R-1R	22.3	R	19.1	1R	16.9	1R	------	------
No. 2009.	Paso Robles	118.0	VR	64.5	2VR	55.5	2VR	50.6	2VR	40.4	3VR	------	------	------	------
No. 2048.	Cupertino	166.0	1-2VR	------	------	------	------	------	------	------	------	------	------	------	------
No. 2120.	Cupertino	133.0	3VR	------	------	------	------	------	------	------	------	------	------	------	------
1894—No. 2168.	Tulare	48.8	2VR	18.6	R	19.0	R	16.2	R	------	------	------	------	------	------
No. 2226.	Mission San José	105.0	2VR	75.5	1VR	64.5	1VR	42.5	1VR	------	------	------	------	------	------
No. 2293.	Mission San José	154.0	VR-1VR	95.2	VR	86.9	1VR	42.5	1VR	------	------	------	------	------	------

RECORD OF TREATMENT.

No. 1245. *Petit Bouschet*, from Margherita Vineyard, Fresno. Received August 28, 1890, in good condition, and mature. The must showed 24.7% of solid contents by spindle and 0.51% of acid. The grapes were mixed with No. 1241, Alicante Bouschet, from the same vineyard.

No. 1378. *Petit Bouschet*, from Mission San José. Received October 20, 1890, in good condition, but overripe and shriveled. The must showed 23.5% of solid contents by spindle and 0.80% of acid. The temperature of the must at crushing was 69°, and the maximum reached was 96°, on the third day. On the fourth day the murk was dry, and was drawn off.

In one month the wine was clear, very raw and astringent, and of very intense color. At three months it was bright and had been racked twice. It had no bouquet, and tasted flat and a little suspicious. An examination of the lees showed the presence of filaments, so the wine was pasteurized. At two months after pasteurizing it was clear, had improved in flavor, developed a little bouquet, and was generally improved. It was of fair quality, but heavy-bodied, very astringent, and coarse. After this it did not improve much, and at seventeen months part of it was put in bottle; at twenty-three months the rest was bottled. At twenty-seven months that first bottled was spoiled; the second was bright, of intense color and good tint, but not of high quality.

No. 1394. *Petit Bouschet*, from Cupertino. A sample for must analysis was received October 21, 1890, in fair condition, but somewhat shriveled and overripe. The must showed 23.7% of solid contents by spindle and 0.69% of acid.

No. 1435. *Petit Bouschet*, from Tulare station. Received August 27, 1891, in good condition; the juice was but slightly colored. The must showed 22.2% of solid contents by spindle and 0.53% of acid. The temperature of the must at crushing was 66°, and the maximum reached was 85°, on the fourth day. On the afternoon of the fourth day the murk was dry, and was drawn off.

In three weeks the wine was nearly clear and quite dry, but very rough and not agreeable. A month later it was clear and sound, but of poor quality and little color. At four months it had been racked twice, and was in good order, with little flavor, but clean taste; in general, was much improved. After this it soon deteriorated, being in a very small keg; and at seven months the lees showed acetic germs and filaments. At nine months it was no longer worth keeping.

No. 1529. *Petit Bouschet*, from Paso Robles station. A sample for must analysis was received October 7, 1891, in good condition. The must showed 20.05% of solid contents by spindle and 0.51% of acid.

No. 1627. *Petit Bouschet*, from Tulare station. Received September 6, 1892, in good condition; the bunches were large and well filled. The must showed 22.2% of solid contents by spindle and 0.57% of acid. The temperature of the must at crushing was 68°, and the maximum reached was 90°, on the third day. On the fifth day the murk was drawn off while still fermenting.

One month after pressing the wine was nearly clear and quite dry. At four months it was bright, not of very pleasing odor, but of good flavor, and generally a good wine. Three months later it was in good condition and the bouquet had much improved. At nine months it had been racked three times and had changed very little since the last tasting. At eleven and at fifteen months it was in good condition—an agreeable wine and perfectly sound, but very light in color for a Bouschet. At nineteen months it was bottled. At three and one half years the bottled wine was bright, of sufficient color, with rather more character than the Refosco of the same locality, but not quite so clean-tasting.

No. 1745. *Petit Bouschet*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 20.4% of solid contents by spindle and 0.51% of acid.

No. 1778. *Petit Bouschet*, from Mission San José. Received October 15, 1892, in good condition. The must showed 21.6% of solid contents by spindle and 0.92% of acid. The grapes were fermented with No. 1767, Herbemont, from the same vineyard.

No. 1882. *Petit Bouschet*, from Tulare station. Received September 17, 1893, in good condition. The bunches were short, irregular, of medium size, well filled, but not compact; the berries were large and well colored, but the juice not very red. They were the healthiest and finest red grapes yet received from Tulare. Most of the grapes were mature, but a few bunches were rather green and seemed to be second crop, though as large as the others. The must showed 21.2% of solid contents by spindle and 0.65% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 93°, on the third day. On the fourth day the murk was dry, and was drawn off.

The wine remained cloudy for six weeks, and tasted flat. In two months it was nearly clear, and was racked and taken to the cellar. At six months it was clear, with some bouquet and flavor, medium acid and astringency, enough color for a red wine, but very little for a Bouschet. At twelve months it was in good order, with more color and flavor than the Mourastel of the same vineyard and year, but not quite so clean-tasting.

No. 2009. *Petit Bouschet*, from Paso Robles station. Received October 26, 1893, in good condition. The bunches were large, winged, and well filled, on large peduncles; the berries of medium size, round, firm, very sweet, and with deep red juice; some berries were dried. The must showed 24.8% of solid contents by spindle and 0.47% of acid. The temperature of the grapes at crushing was 62°, and the maximum reached was 87°, on the third day. On the sixth day the murk was nearly dry, and was drawn off.

In one month the wine was clear, and was racked and taken to the cellar. In three months it was bright, of good flavor and aroma, very astringent, with medium acid—a good, sound wine, but very rough. Tastings at six and at nine months showed a gradual improvement. The wine remained in good order, and at nine months was possessed of flavor and aroma, but was still sub-sweet and very immature.

No. 2048. *Petit Bouschet*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were over medium in size, conical and close; the berries of medium size, were very juicy, and the juice deeply colored, and mature. The must showed 20.4% of solid contents by spindle and 0.80% of acid.

ALICANTE BOUSCHET.

(See Vit. Rept. 1887-89, p. 224.)

This variety has shown itself to be one of the most "solid" wines yet tested. With a good amount of sugar, it has high acid, tannin, and body, being equal in these respects to any of the North Italian varieties. Leaving out of consideration the grapes from grafts of one year, which are not typical, the average composition of the must of this variety for three years, as grown in the Bay region, is 24.2% of sugar and 0.98% of acid. Of the three wines made during this time, the average tannin content was 0.492%, and the body of the only one determined was 3.05%. The wine, when made up alone, is too heavy to be agreeable, but it is clean-tasting, and as a blend for thin wines would be hard to excel. At Fresno this grape has not done well, but was not sufficiently investigated and is worthy of further trial.

From Oakville, Napa County, the Alicante Bouschet is reported as giving a "thin wine of good quality," and as being occasionally subject to coulure. In the St. Helena and Alhambra valleys it has given satisfaction, yielding good crops of grapes excellent for blending purposes. The grapes ripen at about the same time as the Zinfandel, and, though sometimes not ripening very evenly, they are much more resistant than the latter.

ANALYSES OF MUSTS AND WINES.

ALICANTE BOUSCHET.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1241.	Fresno	Aug. 24	22.15	20.61	.71	.42	9.05	11.27	.214	......	.53	2.82
No. 1396.	Cupertino	Oct. 19	25.90	......	1.02	......	......	......	......	......	......	......
1891—No. 1581.	Mission San José	Oct. 13	24.35	22.67	.77	.43	9.56	11.91	.398	.72	.50	3.05
1892—No. 1790.	Mission San José	Oct. 18	23.70	......	.81	......	......	......	......	......	......	......
1893—No. 2046.	Cupertino	Oct. 30	23.70	......	1.25	......	......	......	.604	1.31	......	......
No. 2112.	Cupertino	Oct. 30	23.10	......	1.03	......	......	......	.474	.83	......	......

COLOR READINGS.

ALICANTE BOUSCHET.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Ten Months.	
1890—No. 1241.	Fresno	48.6	3VR	25	4VR	25.7	4-5VR	19.3	2R	14.6	1-2R	13.1	2R	13.1	3VR+Y
1891—No. 1581.	Mission San José	363.0	VR	235	1VR	114.3	1VR	118.3	1VR	105.3	1VR	......		......	
1893—No. 2046.	Cupertino	190.0	1VR	......		......		......		......		......		......	
No. 2112.	Cupertino	148.0	1VR												

RECORD OF TREATMENT.

No. 1241. *Alicante Bouschet*, from Margherita Vineyard, Fresno. Received August 25, 1893, in fair condition. The bunches were large, pyramidal, and sometimes shouldered, on slender but tough peduncles; the berries were round, variable in size, on long, tough pedicels; the grapes were crisp, juicy, and mature. The must showed 22.15% of solid contents by spindle, and 0.71% of acid. The grapes were fermented with No. 1245, Petit Bouschet, in the proportion of 73% of Alicante to 27% of the other. The temperature of the must at starting was 66°, and the maximum reached was 92°, on the third day. On the fifth day the murk was dry, and was drawn off.

The wine was slow in clearing, and fermented quietly for several weeks. At two months it was nearly clear, but tasted a little suspicious. At three months the wine was racked, and taken to the cellar; a little later an examination of the lees showed the presence of filaments, and the wine was pasteurized. After pasteurizing it became clear, but the taste was affected by the secondary fermentation. At nineteen months it was bright, much improved in taste, and quite mature. It was racked for the fourth time, and some of it bottled. When it was two years old it was all bottled. At three and one half years the wine first bottled was spoiled; that bottled later was bright and in good order, but flat and of poor quality.

No. 1396. *Alicante Bouschet*, from Cupertino. A sample for must analysis was received October 21, 1890, in bad condition—shriveled and moldy. The must showed 25.9% of solid contents by spindle and 1.02% of acid.

No. 1581. *Alicante Bouschet*, from Mission San José. Received October 16, 1891, in poor condition, and not quite mature. The must showed 24.35% of solid contents by spindle and 0.77% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 82°, on the third day. On the fourth day the murk was dry, and was drawn off.

At one month the wine was clear, with some aroma and good flavor, full astringency, and good acid. During the first three months it was racked twice, and at the end of that time the lees were examined and found to be sound. At five months it was bright, a round, full-bodied wine, of neutral character, maturing quickly. At seven months it was very smooth and agreeable, but with plenty of tannin. At ten months it was bottled. At three and one half years the bottled wine was bright, of intense color, some bouquet, and good flavor. It was a very heavy but clean-tasting wine—a model blend for improving wines lacking in body, tannin, and color.

No. 1790. *Alicante Bouschet*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 23.7% of solid contents by spindle and 0.81% of acid. The grapes were fermented with No. 1789, Cinsaut, from the same vineyard.

No. 2046. *Alicante Bouschet*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, irregular, winged, loose, coulured; the berries of medium size, juicy, thick-skinned, with good acid and white juice; the grapes were mature. The must showed 23.7% of solid contents by spindle and 1.25% of acid.

No. 2112. *Alicante Bouschet*, from Cupertino. A sample for must analysis was received November 1, 1893, in good condition. The must showed 23.1% of solid contents by spindle and 1.03% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SOUTHERN FRENCH TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Aramon.										
1246	Fresno	1890	21.10	20.99	.65	.36	10.58	.248	.50	.39	2.82
1474	Fresno	1891	21.50		.57		10.42	.210	.66	.44	2.60
1377	Mission San José	1890	22.10		.81	.29	11.45	.149	.71	.36	2.58
2299	Mission San José	1894	22.80		.61			.147	.72		
1414	Cupertino	1890	23.00		.51	.22	12.18	.298	.62	.44	2.82
2054	Cupertino	1893	23.40		62			.345	.79		
1436	Tulare	1891	20.20		.53						
1639	Tulare	1892	21.50	20.44	.57	.34	11.00	.242	.53	.44	2.65
1918	Tulare	1893	21.50	19.21	.74	.44	9.90	.147	.68	.47	2.60
2290	Tulare	1894	22.85	21.80	.48		10.58	.052	.56		2.65
"(*a*)	Tulare	1894	22.85	21.80	.48		10.75	.285	.42	.58	2.60
1659	Amador station	1892	20.30		.76						
1826	Amador station	1893	18.60		.86	.23		.182	.86		
2178	Amador station	1894	20.40		.67						
2316	Amador station	1894	23.40		.45						
1755	Paso Robles	1892	21.50		.48						
	Average, Fresno		**21.30**	**20.90**	**.61**	**.36**	**10.50**	**.229**	**.58**	**.42**	**2.71**
	Average, Mission San Jose		**22.45**		**.71**	**.29**	**11.45**	**.148**	**.72**	**.36**	**2.58**
	Average, Cupertino		**23.20**		**.57**	**.22**	**12.18**	**.322**	**.71**	**.44**	**2.82**
	Average, Tulare		**21.78**	**20.81**	**.56**	**.39**	**10.56**	**.181**	**.55**	**.49**	**2.62**
	Average, Amador station		**20.69**		**.68**	**.23**		**.182**	**.86**		
	Cinsaut.										
1408	Mission San José	1890	22.35		.44	.21	12.36	.122		.41	2.58
1789	Mission San José	1892	22.10		.53						
2307	Mission San José	1894	20.85		.44						
1434	Tulare	1891	25.20	24.22	.52	.64	12.00	.120	.42	.30	3.80
1614	Tulare	1892	22.05	22.24	.58		10.90	.103	.43	.47	2.95
1842	Tulare	1893	21.95	20.24	.62	.37	11.00	.083	.52	.49	2.60

Number	LOCALITY.	Vintage of	MUST.			WINE.					
			Solid Contents by Sp ndle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Cinsaut—Continued.										
2138	Tulare	1894	22.00	21.38	.47	......	10.58	.136	.42	.42	2.60
1477	Paso Robles	1891	18.60	......	.58	......	......	......	......	......	......
1655	Paso Robles	1892	22.60	......	.57	......	......	......	......	......	......
1825	Amador station	1893	21.05	......	.69	......		.284	.83	......	......
2159	Amador station	1894	26.50	......	.45	......	......	......	......	......	......
2060	Cupertino	1893	19.10	......	.61	......	......	.467	.79	......	......
	Average, Mission San Jose	......	**21.77**	......	**.47**	**.21**	**12.36**	**.120**	**.42**	**.30**	**3.80**
	Average, Tulare	......	**22.80**	**22.02**	**.55**	**.50**	**11.12**	**.110**	**.45**	**.42**	**2.99**
	Average, Paso Robles	......	**20.60**	......	**.58**	......	......	......	......	......	......
	Average, Amador station	......	**23.88**	......	**.57**	......	......	**.284**	**.83**	......	......
	Grenache.										
1249	Fresno	1890	24.10	23.72	.57	.40	12.07	.153	.55	.46	3.02
1333	Cupertino	1890	24.35	......	.62	......	......	......	......	......	......
1444	Tulare	1891	22.60	......	.53	......	......	......	......	......	......
1626	Tulare	1892	23.25	23.13	.47	.35	11.73	.172	.55	.48	2.90
1845	Tulare	1893	22.80	20.61	.53	.33	11.00	.109	.52	......	2.70
2170	Tulare	1894	25.10	24.97	.47	......	12.91	.150	.40	.44	2.85
1527	Paso Robles	1891	24.40	24.12	.45	......	12.09	.180	......	.40	2.55
1721	Paso Robles	1892	22.60	22.23	.56	.45	11.27	.146	.50	.55	2.85
2010	Paso Robles	1893	28.20	27.65	.51	.29	13.54	.224	.51	.60	2.85
1822	Amador station	1893	23.25	......	.74	......	......	.288	.80	......	......
2193	Amador station	1894	28.00	......	.46	......	......	......	......	......	......
	Average, Tulare	......	**23.44**	**22.90**	**.50**	**.34**	**11.88**	**.144**	**.49**	**.46**	**2.82**
	Average, Paso Robles	......	**25.07**	**24.67**	**.51**	**.37**	**12.30**	**.183**	**.51**	**.52**	**2.75**
	Average, Amador station	......	**25.63**	......	**.60**	......	......	**.288**	**.80**	......	......

	Ploussard.										
1261	Mission San José	1890	24.80	------	.55	.34	12.18	.115	.46	.41	2.95
1506	Mission San José	1891	25.30	25.41	.45	------	12.64	.188	.41	.42	3.05
1637	Mission San José	1892	22.00	------	.57	------	------	------	------	------	------
1983	Mission San José	1893	25.90	24.75	.56	------	13.27	.182	.58	.61	2.80
1291	Cupertino	1890	25.10	------	.57	.21	------	------	------	------	------
	Average, Mission San Jose	------	**24.50**	**25.08**	**.53**	**.34**	**12.69**	**.162**	**.48**	**.48**	**2.93**
	Trousseau.										
1204	Fresno	1890	22.27	22.05	.58	.52	11.00	.084	.47	.43	2.60
1458	Fresno	1891	27.65	------	.61	------	19.28	.160	.56	.20	6.85
1498	Asti, Sonoma County	1891	24.60	23.13	.41	.39	12.18	.065	------	.47	2.70
1510	Mission San José	1891	25.20	23.31	.53	------	------	------	------	------	------
1925	Paso Robles	1893	26.90	26.12	.26	.34	------	.176	.38	------	------
2335	Tulare	1894	26.80	------	.30	------	------	------	------	------	------
	Bastardo.										
1354	Cupertino	1890	25.77	------	.44	------	------	------	------	------	------
2047	Cupertino	1893	28.00	------	.63	------	------	.252	.75	------	------
1479	Paso Robles	1891	22.90	------	.43	------	------	------	------	------	------
1641	Paso Robles	1892	22.15	------	.64	------	------	------	------	------	------
1865	Paso Robles	1893	23.90	22.95	.49	.34	11.48	.151	.38	.40	2.80
1625	Tulare	1892	24.80	------	.41	------	------	------	------	------	------
2149	Tulare	1894	26.50	------	.41	------	------	------	------	------	------
1709	Mission San José	1892	23.70	22.95	.85	.26	------	------	------	------	------
2266	Mission San José	1894	25.90	------	.47	------	------	------	------	------	------
1834	Amador station	1893	24.80	------	.72	------	------	.358	.68	------	------
	Average, Cupertino	------	**26.89**	------	**.54**	------	------	**.252**	**.75**	------	------
	Average, Paso Robles	------	**22.98**	**22.95**	**.52**	**.34**	**11.48**	**.151**	**.38**	**.40**	**2.80**
	Average, Tulare	------	**25.65**	------	**.41**	------	------	------	------	------	------
	Average, Mission San Jose	------	**27.20**	------	**.68**	**.26**	------	------	------	------	------
	Chauché noir.										
1227	Fresno	1890	28.40	28.62	.34	.56	------	------	------	------	------
1290	Cupertino	1890	25.00	------	.55	------	------	------	------	------	------
2109	Cupertino	1893	30.90	------	.65	------	------	.307	------	------	------
1298	Mission San José	1890	26.30	------	.53	.39	13.27	------	------	.32	2.45
1685	Mission San José	1892	24.10	------	.64						

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SOUTHERN FRENCH TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Chauché noir—Continued.										
1868	Paso Robles	1893	21.95	20.99	.92		10.42	.112	.45	.56	3.10
1832	Amador station	1893	25.00		.68			.362	.67		
	Average, Cupertino		**27.95**		**.60**			**.307**			
	Average, Mission San Jose		**26.50**		**.55**	**.39**	**13.63**	**.173**	**.54**	**.36**	**2.78**
	Average, Tulare		**26.03**	**21.38**	**.53**	**.60**	**10.58**		**.56**		**3.80**
	Average, Paso Robles		**21.12**	**20.99**	**1.15**		**10.42**	**.112**	**.45**	**.56**	**3.10**
	Dolcetto.										
1348	Cupertino	1890	19.50		.80						
2111	Cupertino	1893	26.90		.58			.259			
1572	Asti, Sonoma County	1891	27.45	27.65	.31	.30					
	Average, Cupertino		**23.20**		**.69**			**.259**			
	Carignane.										
1251	Fresno	1890	20.60	19.89	.74	.41	11.09	.125	.56	.48	2.36
1335	Cupertino	1890	21.50		.72						
1409	Mission San José	1890	24.80		.95	.33	12.64	.213	.65	.66	3.08
1409	Mission San José (closed vat)	1890	24.80		.95	.27	13.09	.199		.54	2.82
1409	Mission San José (calc. sulph.)	1890	24.80		.96	.45	12.91	.213		.62	3.94
1409	Mission San José (calc. phosph.)	1890	24.80		.95	.40	12.18	.180		.56	3.22
1409	Mission San José (amm. phosph.)	1890	24.80		.95	.39	12.36	.217		.48	3.82
1791	Mission San José	1892	20.60		.99						
2295	Mission San José	1894	20.20		.88						
1447	Tulare	1891	21.70		.44						
1628	Tulare	1892	21.50	18.89	.59	.38	10.42	.143	.54	.56	3.30
1887	Tulare	1893	20.60	18.90	.71	.26	9.90	.070	.56	.53	2.60
2210	Tulare	1894	22.20	21.22	.47		10.42	.146	.53	.44	2.60
1525	Asti, Sonoma County	1891	24.40	23.61	.48	.33	12.54	.240	.57	.48	2.78

1676	Paso Robles	1891	19.70	17.44	.67	.85	9.00	.123	.63	.48	2.60
1742	Paso Robles	1892	24.80	------	.85	------	------	------	------	------	------
2041	Paso Robles	1893	25.90	24.12	.51	.34	12.18	.154	.47	.48	3.30
1871	Amador station	1893	23.30	20.61	.90	.22	------	.400	------	------	------
2178	Amador station	1894	22.60	------	.68	------	------	------	------	------	------
2323	Amador station	1894	25.40	------	.53	------	------	------	------	------	------
	Average, Mission San Jose	------	**21.89**	------	**.94**	**.33**	**12.64**	**.213**	**.65**	**.66**	**3.08**
	Average, Tulare	------	**21.50**	**19.67**	**.55**	**.31**	**10.25**	**.120**	**.54**	**.51**	**2.83**
	Average, Paso Robles	------	**26.47**	**20.78**	**.51**	**.35**	**10.59**	**.139**	**.55**	**.48**	**3.45**
	Average, Amador station	------	**23.77**	**20.61**	**.70**	**.22**	------	**.400**	------	------	------
	Mataro.										
1252	Fresno	1890	21.30	20.24	.53	.42	10.58	.104	.50	.43	2.32
1255	Amador station	1890	22.40	------	.41	.40	11.45	.156	.63	.50	2.58
2172	Amador station	1894	26.00	------	.33	------	------	------	------	------	------
1574	Asti, Sonoma County	1891	23.05	22.67	.56	.36	12.09	.129	.55	.44	2.35
1596	Asti, Sonoma County	1891	25.00	23.04	.50	.31	13.27	.236	.93	.82	3.35
1609	Mountain View	1891	20.70	20.24	.78	.32	10.75	.143	.78	.52	2.55
1611	Mountain View	1891	21.50	20.99	.70	------	11.45	.255	.71	.39	2.55
1610	San José; Dr. Dudley	1891	22.08	21.80	.77	.40	11.45	.162	.74	.55	2.45
1727	Paso Robles	1892	21.95	------	.47	------	------	------	------	------	------
1921	Paso Robles	1893	22.60	20.99	.60	.23	10.17	.070	.58	.42	2.30
2313	Tulare	1894	23.00	------	.28	------	------	------	------	------	------
	Average, Amador station	------	**24.20**	------	**.37**	**.40**	**11.45**	**.156**	**.63**	**.50**	**2.58**
	Average, Asti, Sonoma County	------	**24.03**	**22.86**	**.53**	**.34**	**12.68**	**.183**	**.74**	**.63**	**2.35**
	Average, Mountain View	------	**21.10**	**20.62**	**.74**	**.32**	**11.10**	**.199**	**.75**	**.46**	**2.55**
	Average, Paso Robles	------	**22.80**	**20.99**	**.44**	**.23**	**10.17**	**.070**	**.58**	**.42**	**2.30**
	Mourastel.										
1326	Cupertino	1890	18.40	------	1.37	.31	9.45	.099	.81	.62	2.32
2045	Cupertino	1893	24.35	------	.86	------	------	.234	.93	------	------
1330	Mission San José	1890	21.50	------	.99	.24	10.75	.191	.78	.52	2.75
1569	Mission San José	1891	21.70	------	.90	------	10.91	.152	.88	.52	2.75
2074	Mission San José	1893	22.10	20.99	.83	.23	10.58	.163	.78	.53	2.30
2343	Mission San José	1894	20.40	------	.57	------	------	.133	.58	------	------
1439	Tulare	1891	19.70	------	.64	------	------	------	------	------	------
1690	Tulare	1892	21.50	21.38	.41	.33	10.67	.143	.48	.50	2.80
1898	Tulare	1893	22.00	20.99	.71	.33	10.17	.087	.69	.47	2.45
2278	Tulare	1894	22.60	21.38	.50	------	------	.139	.55	.45	2.60
1471	Fresno	1891	20.85	19.89	.80	.65	10.17	.168	.63	.53	2.70
1528	Paso Robles	1891	20.60	20.24	.62	.34	------	------	------	------	------
1759	Paso Robles	1892	23.70	------	.46	------	------	------	------	------	------
2071	Paso Robles	1893	24.25	23.91	.50	.33	11.91	.166	.63	.45	2.80
1863	Amador station	1893	21.10	------	1.03	------	------	------	------	------	------
2176	Amador station	1894	24.40	------	.49	------	------	------	------	------	------

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Mourastel—Continued.										
	Average, Cupertino	......	**21.38**	......	**1.11**	**.31**	**9.45**	**.167**	**.87**	**.62**	**2.32**
	Average, Mission San Jose	......	**21.42**	**20.99**	**.82**	**.24**	**10.74**	**.159**	**.73**	**.52**	**2.60**
	Average, Tulare	......	**21.45**	**21.35**	**.56**	**.33**	**10.42**	**.123**	**.57**	**.47**	**2.62**
	Average, Paso Robles	......	**22.85**	**22.08**	**.53**	**.34**	**11.91**	**.166**	**.63**	**.45**	**2.80**
	Average, Amador station	......	**22.75**	......	**.76**	......	......	......	**.76**	......	......
	Beclan.										
1927	Paso Robles	1893	23.25	22.04	.50	.25	......	.259	.47	......	......
2273	Mission San José	1894	23.70	22.90	.45	......	......	......	......	......	......
1967	Tulare	1893	24.80	23.42	.23	.36	11.48	.138	.42	......	......
2314	Tulare	1894	24.50	......	.33	......	......	......	......	......	......
	Average, Tulare	......	**24.65**	**23.42**	**.28**	**.36**	**11.48**	**.138**	**.42**	......	......
	Petit Bouschet.										
1245	Fresno	1890	24.70	25.76	.51	.41	......	......	......	......	......
1378	Mission San José	1890	23.50	......	.80	.39	11.36	.485	.83	.37	3.32
1778	Mission San José	1892	21.60	21.80	.92	......	......	......	......	......	......
2226	Mission San José	1894	19.70	19.21	.73	......	8.07	.266	.77	.62	3.30
2293	Mission San José	1894	21.50	......	.58	......	9.54	.345	......	.49	3.50
1394	Cupertino	1890	23.70	......	.69	......	......	......	......	......	......
2048	Cupertino	1893	20 40	......	.80	......	......	.478	......	......	......
2120	Cupertino	1893	18.60	......	.84	......	......	.502	......	......	......
1485	Tulare	1891	22.20	22.05	.53	.50	11.00	.227	.43	.45	3.12
1627	Tulare	1892	22.20	21.38	.57	.45	11.09	.185	.58	.50	3.05
1882	Tulare	1893	21.20	19.54	.65	.32	10.08	.221	.48	.52	2.85
2168	Tulare	1894	22.30	21.80	.48	......	10.58	.298	.55	.35	2.85
1529	Paso Robles	1891	20.06	......	.51	.45	......	......	......	......	......
1745	Paso Robles	1892	20.40	......	.51	......	......	......	......	......	......

2009	Paso Robles	1893	24.80	24.12	.47	.29	11.91	.480	.48	.47	3.10
	Average, Mission San Jose		**21.57**	**20.50**	**.76**	**.39**	**9.66**	**.365**	**.80**	**.49**	**4.37**
	Average, Cupertino		**20.90**		**.78**			**.488**			
	Average, Tulare		**21.97**	**21.19**	**.54**	**.42**	**10.67**	**.232**	**.51**	**.45**	**2.97**
	Average, Paso Robles		**21.75**	**24.12**	**.49**	**.37**	**11.91**	**.480**	**.48**	**.47**	**3.10**
	Alicante Bouschet.										
1241	Fresno	1890	22.15	20.61	.71	.42	11.27	.214		.53	2.82
1396	Cupertino	1890	25.90		1.02						
2046	Cupertino	1893	23.70		1.25			.604	1.31		
2112	Cupertino	1893	23.10		1.03			.474	.83		
1581	Mission San José	1891	24.35	22.67	.77	.43	11.91	.398	.72	.50	3.05
1790	Mission San José	1892	23.70		.81						
	Average, Cupertino		**24.23**		**1.10**			**.539**	**1.07**		
	Average, Mission San Jose		**24.00**	**22.67**	**.79**	**.43**	**11.91**	**.398**	**.72**	**.50**	**3.05**

NORTH ITALIAN TYPE—RED.

(See Vit. Rept. 1887–89, p. 117.)

The judgment expressed in the last report regarding the grapes of the North Italian type has been but slightly modified by later experiments. Some of the finer varieties, such as the Nebbiolo and Bonarda, while making excellent wines of their class, have not borne sufficiently to be recommended for any of the localities yet tried. Certain others, such as the Dolcetto, while bearing well, have not shown sufficient quality to encourage their dissemination. The Marzemino is worthy of further study. The varieties which have given the best results are the Refosco ("Crabb's Burgundy"), Barbera, and Fresa. The first of these shows the widest adaptability, producing well and giving good wine, both in the coast counties and in the interior valleys. It is especially promising for the San Joaquin Valley, where, together with the Barbera and the Tinta Valdepeñas, very good results have been obtained in the production of dry, red wines. The Barbera has not succeeded well in the coast counties, and, except perhaps in some extra hot location, is not to be recommended for that region. The Fresa has done well at Cupertino and at Paso Robles, and would doubtless be successful in other parts of the lower coast counties. It has, however, a very marked flavor, somewhat resembling that of Zinfandel, which many people would not find agreeable and it would therefore be inadvisable to plant it too freely.

The especial advantage possessed by the North Italian type of grapes is that they supply a large proportion of acid together with high sugar content, and that they resist exposure on the vines remarkably well and supply bunches sound throughout. They are therefore desirable for wine-making in hot climates, not only by themselves, but especially for blending with other varieties whose acid content falls so low under the influence of heat as to jeopardize sound fermentation and produce flavorless wines.

NEBBIOLO.

(See Vit. Rept. 1885–86, p. 87; 1887–89, p. 127.)

A full description of this variety is given in the places cited, and later results have confirmed the opinions expressed there. The vine is healthy, but a small grower, and with its small leaves is apt to allow the grapes to sunburn. The wine is of excellent quality, but lacking in color, and not sufficiently superior to other of the Italian varieties to make up for its deficiency in bearing. In all the localities tried the must is characterized, like that of most of the North Italian varieties, by its high acidity and high sugar. At Tulare and at Paso Robles stations, however, the acidity is lower than in the case of Barbera. The color is irregular, like that of the Aramon. Occasionally in the Bay region it will be sufficient and of fairly good tint, but generally it is very light and yellowish.

ANALYSES OF MUSTS AND WINES.

NEBBIOLO (FINO, BOURGU, ETC.).	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
1890—No. 1285. Cupertino	Oct. 1	22.80		.82	.22						
No. 1364. Cupertino	Oct. 14	23.70		.96							
1891—No. 1575. Asti, Sonoma County	Oct. 8	*26.90	27.65	.45	.26	11.08	13.54	.281	.69	.50	3.20
1892—No. 1695 (Fino). Tulare	Sept. 27	22.80		.80							
No. 1700 (Bourgu). Tulare	Sept. 27	25.40		.41							
1893—No. 1857 (Fino). Amador station	Sept. 14	20.60		1.15							
No. 1858 (Bourgu). Amador station	Sept. 14	20.20		1.07							
No. 1938 (Bourgu). Paso Robles	Oct. 12	25.90	24.97	.53	.34			.281			
No. 2039 (Bourgu). Cupertino	Oct. 30	23.70		1.26				.387			
No. 2058 (Fino). Cupertino	Oct. 30	23.30		1.14				.352			
1894—No. 2277. Asti, Sonoma County	Oct. 6	22.20	21.38	.99	.31						

* Added water and tartaric acid before fermentation.

RECORD OF TREATMENT.

No. 1285. *Nebbiolo*, from Cupertino. A sample for must analysis was received October 3, 1890, in good condition, but not quite ripe. The must showed 22.8% of solid contents by spindle and 0.82% of acid.

No. 1364. *Nebbiolo bourgu*, from Cupertino. A sample for must analysis was received October 17, 1890, in good condition, and mature. The must showed 23.7% of solid contents by spindle and 0.96% of acid.

No. 1575. *Barolo*, from Asti, Sonoma County. Received October 10, 1891, in good condition, and mature, a few of the grapes beginning to dry. The grapes were apparently identical with the Nebbiolo fino. The must showed 26.9% of solid contents by spindle and 0.45% of acid. The temperature of the grapes at crushing was 63°. One hundred and four pounds were crushed and put to ferment with an addition of 68 grs. of tartaric acid and ¾ gal. of water. The maximum temperature reached was 85°, on the fourth day. The must fermented slowly, but was dry on the seventh day, when it was drawn off.

At one month the wine was clear, of full and agreeable flavor and aroma, and high astringency. At two months it was racked, and at four months the lees were examined and found to be perfectly sound. At five months the wine was bright, with some bouquet and full flavor, high body and astringency, rough, but very promising. An examination of the lees showed them to be perfectly sound. Three months later the wine was in good condition, a heavy-bodied, alcoholic wine, but toned down considerably since last tasting. At fifteen months it was excellent in every respect except in color, which was very light. At sixteen months it was bottled, on account of the smallness of the keg. Two years after bottling the wine was bright, with some bouquet and good flavor, clean taste, and high astringency, much superior to the wine of Mataro of the same year and locality.

No. 1695. *Nebbiolo fino*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 22.8% of solid contents by spindle and 0.80% of acid.

No. 1700. *Nebbiolo bourgu*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 25.4% of solid contents by spindle and 0.41% of acid.

No. 1857. *Nebbiolo fino*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition, but not mature. The must showed 20.6% of solid contents by spindle and 1.15% of acid. The bunches were small, compact, cylindrical; the berries small.

No. 1858. *Nebbiolo bourgu*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. This sample seems to be identical with No. 1857. The must showed 20.2% of solid contents by spindle and 1.07% of acid.

No. 1938. *Nebbiolo bourgu*, from Paso Robles station. A sample for must analysis was received October 13, 1893, in good condition, sweet and mature. The bunches were of good size, conico-cylindrical, close; the berries round, reddish, and very juicy. The must showed 25.9% of solid contents by spindle and 0.53% of acid. The vines were grown in sandy soil, pruned long, and bore at the rate of about one ton per acre.

No. 2039. *Nebbiolo bourgu*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition, and mature. The bunches were under medium size, cylindrical, with small wings, well filled; the berries small, very acid. The must showed 23.7% of solid contents by spindle and 1.26% of acid.

No. 2058. *Nebbiolo fino*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, long cylindrical, with a small wing, close; the berries of medium size, round, well colored, crisp, juicy, with good acid, and mature. The must showed 23.3% of solid contents by spindle and 1.14% of acid.

BARBERA.

(See Vit. Rept. 1883-85, p. 111; 1885-87, p. 85; 1887-89, p. 134.)

The last experiments with the Barbera have been principally with grapes from the Tulare station, to which locality it seems particularly well suited. The vines of this variety are there planted in sandy soil where the alkali is not very strong, and they make a strong and healthy growth. They produce about five tons per acre of fine, clean grapes. The grapes are thick-skinned, not too close, and very resistant to injuries from any source. They are firm, juicy, fresh-tasting, and ripen well without losing their acid. The average composition of the must for four years has been 24% of solid contents, and 0.76% of acid—an excellent ratio between sugar and acid, insuring good fermentation. This is a lower ratio of acid to sugar than is given by the same grape in cooler localities, but is well up to the average, and better than is given by any other grape yet tried at Tulare. In tannin it falls much below the amount obtained from it in other localities, an average of 0.173% compared to 0.274% at Cupertino.

The first wine made from this variety at Tulare, while the vines were young, was lacking in color, but was of good quality and marked character. The wines made after the first year were of good color, acid, and body, but still rather low in tannin. A blend with a grape like Gros Mansenc, St. Macaire, or, best of all, Refosco, is needed to increase the tannin, and improve the keeping qualities. No. 1573 is a good example of the heavy Italian type of wines, with high alcohol and full acid, astringency, and body. This wine, notwithstanding the smallness of the quantity made, was not fully aged at three years and a half.

The Barbera, then, seems to be very well suited to the warmer localities of the State, but requires blending to make a good commercial wine. When grown on warm, hillside soils, such as those of the Asti Vineyard in the upper Russian River Valley, it should be blended with some lighter grape to decrease its roughness and hasten its maturity; but in the rich valley soils, such as those of Tulare, it needs the addition of some robust grape to improve its keeping qualities.

This variety has received a very thorough test at Cupertino, and more especially on Prof. Hilgard's vineyard at Mission San José. At the latter place, as was pointed out in the last report, its chief fault has been irregularity of bearing. Prof. Hilgard has found that its bearing qualities are much better when grafted on Californica stock than when on Riparia.

ANALYSES OF MUSTS AND WINES.

BARBERA.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1324.	Cupertino	Oct. 11	27 65	......	.50	......	......	......	......	......	......	......
1891—No. 1445.	Tulare	Aug. 26	25.65	......	.77	......	......	......	......	......	......	......
No. 1573.	Asti, Sonoma County	Oct. 9	28.80	28.52	.75	.40	11.62	14.20	.265	.85	.52	3.25
1892—No. 1675.	Tulare	Sept. 18	24.55	25.76	.65	.71	9.78	12.18	.124	......	.56	3.20
1893—No. 1931.	Tulare	Oct. 12	23.50	21.22	1.03	.41	9.56	11.91	.192	.89	.58	3.40
No. 2040.	Cupertino	Oct. 30	25.90	......	1.32				.441	......	......	......
1894—No. 2211.	Tulare	Sept. 28	24.80	23.61	.60	......	10.07	12.50	.204	.65	.52	3.11
No. 2276.	Asti, Sonoma County	Oct. 6	25.30	24.12	.79	......	......	......	......	......	......	......

COLOR READINGS.

BARBERA.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1573.	Asti, Sonoma County	72.7	2VR	72.7	2VR	50.6	2VR	31.3	3VR	27.0	5VR	......	
1892—No. 1675.	Tulare	Color too light for the scale.											
1893—No. 1931.	Tulare	90.9	1VR	82.5	1VR	32.0	2VR	25.9	3VR	22.0	4VR	20.1	5VR
No. 2040.	Cupertino	129.0	1-2VR	......		......		......		......		......	
1894—No. 2211.	Tulare	46.0	2VR	34.7	1VR	20.5	5VR	18.4	5VR	......		......	

Record of Treatment.

No. 1324. *Barbera*, from Cupertino. A sample for must analysis was received October 13, 1890, in poor condition, quite mature. The must showed 27.65% of solid contents by spindle and 0.50% of acid.

No. 1415. *Barbera*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 25.65% of solid contents by spindle and 0.77% of acid.

No. 1573. *Barbera*, from Asti, Sonoma County. Received October 10, 1891, in fair condition, quite mature. The must showed 28.8% of solid contents by spindle and 0.75% of acid. The 171 lbs. were crushed on the day of arrival, at a temperature of 62°. The maximum reached was 94°, on the fourth day. The wine was nearly dry on the sixth day and was drawn off on the seventh.

At five weeks the wine was clear, well flavored, and full-bodied; it was very fruity and had a trace of sugar. A month later it was bright and sound; it was racked, and the lees showed no unsoundness. At four months the lees showed a few filaments, but the wine was quite bright, dry, and very good but for a slightly bitter after-taste. At five months it was bright, extremely smooth, and fruity, with rather less tannin than is usual for Barbera, but quite sufficient. It was racked for the third time at ten months, and the lees seemed sound. At sixteen months the wine showed very high quality, but a slightly bitter after-taste. Two months later it was racked and part put in bottle. At twenty-two months it had retained its high quality, and the rest of it was bottled. At three years and a half the bottled wine was bright, not deeply colored, with good bouquet and flavor, clean taste, developing well, but still a little too rough.

No. 1675. *Barbera*, from Tulare station. Received September 21, 1892, in good condition, and mature. The must showed 24.53% of solid contents by spindle and 0.65% of acid. The 114 lbs. were crushed at a temperature of 68°. The maximum reached was 77°, on the third day, when it was racked off.

At one month the wine was clear and clean-tasting, but almost without color. At four months it was bright, agreeable, fruity, almost sweetish, but quite sound. The lees were examined and found to be sound, and the wine was racked for the second time at six months. At nine months it was dry and in good order. At eleven months it was a fair wine, with a marked but not very delicate bouquet. Four months later it had lost nearly all its color, but had kept fairly well. At seventeen months it was bottled.

No. 1931. *Barbera*, from Tulare station. Received October 13, 1893, in good condition. The bunches were of medium size, close, cylindrical; the berries large to medium, oval, firm, but juicy, thick-skinned, mature, with fresh taste and pleasing acid. The weight of grapes crushed was 178 lbs., and the must showed 23.5% of solid contents by spindle and 1.03% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 91°, on the third day. The wine was dry on the fifth day, and was pressed on the sixth.

At the end of one month the wine was not quite clear, and still a little sweet. A week later it was racked and taken to the cellar; and at four months it was bright, with some bouquet and flavor, full acid and clean taste. Two months later it had improved, but was still very rough. At ten months the wine was good, but a little flat. An examination of the lees showed the presence of a few filaments. The wine was racked for the third time, and part of it put in bottle. At sixteen months it had changed little from the last tasting; it was a full-bodied, well-colored wine, but not quite clean-tasting. A month later it was racked again and part put in bottle.

No. 2040. *Barbera*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, conical, loose, and coulured; the berries of over medium size when not abortive, ripe, but with very high acid. The must showed 25.9% of solid contents by spindle and 1.32% of acid.

BONARDA.

(See Vit. Rept. 1887-89, p. 144.)

For the description of this variety see the above reference. Three distinct varieties have been received and planted at the stations under this name. Like many Italian names, Bonarda is used to designate several varieties of grapes in different localities of Italy. This makes the correct determination of Italian varieties very difficult. One of the varieties which we have received under this name, however, seems to be the true Bonarda of Piedmont and is the one here referred to. It is very similar in character to other North Italian grapes we have tried. It gives excellent color and is characterized by high acid and the roughness of its wine when new. So far, it has not borne very well, but the character of its grapes and wine makes it desirable to experiment with in other localities.

Another variety received under this name is more promising as a table-grape than as a wine-grape. It is a large, round grape, with a full, agreeable flavor, something like that of the true Malvoisies. It seems to be very close to, if not identical with, the Dolcetto as grown at the Swiss-Italian colony of Sonoma County. This latter is one of the most widely grown grapes of northern Italy, where it is highly appreciated on account of its heavy-bearing qualities, and is used both as a table-grape and for the making of common red wines.

ANALYSES OF MUSTS AND WINES.

BONARDA.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1362. Cupertino	Oct. 14	22.82	......	.72	.22	9.41	11.73	.400	.71	.32	2.70
No. 1384. Cupertino	Oct. 21	25.20	......	1.02	.90	9.92	12.36	.286	......	.60	2.58
No. 1385. Cupertino	Oct. 19	24.45	......	1.09	......	......	......	......	......	......	......
1891—No. 1599. Cupertino	Oct. 23	24.80	......	.91	.33	9.92	12.36	.356	.83	.83	3.35
1893—No. 1869. Paso Robles	Sept. 13	22.80	19.89	.45	.41	8.06	10.08	.134	.41	.57	2.80
No. 2108. Cupertino	Nov. 1	25.00	......	.68	......	......	......	.496	......	......	......
No. 2110 (No. 2). Cupertino	Nov. 1	24.80	......	.78	......	......	......	.253	......	......	......
1894—No. 2310. Tulare	Oct. 13	26.50	......	.39	......	......	......	......	......	......	......

COLOR READINGS.

BONARDA.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.	
1891—No. 1599. Cupertino	20.9	R	14.7	1R	12.5	3R	13.3	2VR+Y	11.6	3VR+Y
1893—No. 1869. Paso Robles	8.6	3R	9.0	3R	......	......	......	......	......	......
No. 2108. Cupertino	97.5	VR-1VR	......	......	......	......	......	......	......	......
No. 2110. Cupertino	15.4	5VR	......	......	......	......	......	......	......	......

RECORD OF TREATMENT.

No. 1362 *Bonarda*, from Cupertino. Received October 17, 1890, in good condition, and mature. The must showed 22.82% of solid contents by spindle and 0.72% of acid. There were 126 lbs. crushed, the initial temperature being 64°; the maximum reached was 82°, on the third day. On the fifth day the wine was nearly dry, and was drawn off.

At one month the wine was nearly clear, of deep color, without aroma, with very high astringency and medium acid, still very raw and undeveloped. One month later the lees were examined, found to be in good condition, and the wine was racked. At three months it was bright, with light bouquet and good flavor, remarkably high astringency, good body and vinosity; in general, very rough, but promising. An examination of the lees showed the presence of some short filaments, and though the taste was unaffected, the wine was pasteurized. Three months after pasteurizing it was bright, still very rough, but of excellent flavor and general quality. At seven months it was racked for the third time. At fourteen months it was in good order, of deep color, good flavor and bouquet, and was maturing well. At seventeen months it was racked and part put in bottle; at twenty-three months the rest was bottled. At three years and three months both samples were sound, but not clear, very rough, and had deposited much sediment.

No. 1384. *Bonarda No. 2*, from Cupertino. This grape is distinct from the Bonarda numbered 1362, and is apparently the Bonarda di Gattinara or Uva Rara, with the description of which in Pulliat and Rovasenda it agrees. The grapes were received October 23, 1890, and 172 lbs. were crushed. The must showed 25.2% of solid contents by spindle and 1.02% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 92°, on the third day. The wine was still a little sweet on the fourth day, when it was racked.

At one month the wine was clear, and showed very high acid and astringency. At two months it was racked, and the lees were sound. At three months the lees showed a few filaments, but the wine was bright, with very good bouquet and flavor, and clean taste; it was, however, pasteurized for safety. At seven months it was bright and showed high quality; it was still rough, but had commenced to mature. At eight months it was racked for the third time. At fifteen months it was in good order, with fair but yellowish color, full rich bouquet and flavor, clean taste, high astringency, and good body. It was nearly mature, and two months later it was racked and part put in bottle; at twenty-five months the remainder was bottled. At three years and three months both bottled samples were bright and in first-class order. That first bottled was of better color and fresher taste than the second, but not so smooth; both were very good wines, but somewhat lacking in color, and rather rough.

No. 1385. *Bonarda No. 1*, from Cupertino. This grape was received under the name of Provinante; it is probably the Pruiné, as it agrees very closely with the description of that variety as given by Rovasenda. The grapes were received October 21, 1890, in good condition, and mature. The must showed 24.45% of solid contents by spindle and 1.09% of acid. Only a sample for must analysis was received.

No. 1599. *Bonarda*, from Cupertino. Received October 24, 1891, in good condition. The must showed 24.8% of solid contents by spindle and 0.91% of acid. There were 47 lbs., which were crushed at a temperature of 66°; the maximum reached was 75°, on the sixth day. On the ninth day the wine was drawn off while still a little sweet.

Three weeks after pressing the wine was clear, dry, with high acid and astringency. At four months the wine was racked for the second time, and the lees were sound. At five months the wine was bright, with full bouquet and flavor, very rough, but of excellent promise. The lees were examined and found to be sound, and two months later the wine had improved, and although still crude was of great solidity and promise. At eight months it was racked for the third time.

No. 1869. *Bonarda*, from Paso Robles station. A small sample was received September 15, 1893, in good condition. The bunches were over medium in size, conico-cylindrical, very compact; the berries were of medium size, well colored, and very sweet. The must showed 22.8% of solid contents by spindle and 0.45% of acid. The grapes were fermented for color and tannin tests.

No. 2108. *Bonarda*, from Cupertino. A sample for must analysis was received November 1, 1893, in good condition. The bunches were over medium in size, long cylindrical, winged, and well filled; the berries were of medium size, round, thick-skinned, and very sweet. The must showed 25.0% of solid contents by spindle and 0.68% of acid.

No. 2110. *Bonarda No. 2* (Uva Rara), from Cupertino. A sample for must analysis was received November 1, 1893, in good condition. The bunches were large, conical, heavily shouldered, compact; the berries were over medium in size, pulpy, very sweet, but with high acid. This variety bears great resemblance to No. 2111, Dolcetto, but the berries are not so hard and have less of the distinctive flavor. (Nos. 2110 and 2111 are probably identical. Prof. Hilgard.)

FRESA.

(See Vit. Rept. 1887-89, p. 149.)

The best results with this variety so far have been obtained at the Cupertino and the Paso Robles stations. At the former the average composition of the must has been 24.8% of sugar and 0.77% of acid—a lower percentage of acid than has been obtained with most of the other Italian varieties. At Paso Robles station the ratio of acid to sugar has been still lower, but quite sufficient; at Tulare, the acid percentage has been rather low, and as the vines have borne poorly they seem unsuited to that locality. From all localities the wine has heavy body and high astringency. It has a very marked and peculiar flavor, coarse but not unpleasant, something of the same nature as the special flavor of the Zinfandel, rendering it unsuitable for blends where a neutral wine is desired. Like the other Italian wines it is at first very rough, and even slower to mature than the others, and even with aging it does not attain the delicacy of the Nebbiolo or the Barbera. The color of the wine is somewhat yellowish, and, except at Cupertino, is insufficient in intensity. Of the localities tested, the Fresa seems to be best suited to Paso Robles, where, with the help of some color grape, it could be used for the production of a common wine of rather better character and keeping qualities than that of the Zinfandel.

ANALYSES OF MUSTS AND WINES.

FREISA DI MONFERRATO, OR FRESA.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
							By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1327.	Cupertino	Oct. 11	23.90	......	.94	.21	9.78	12.18	.451	.97	.53	3.08
1891—No. 1469.	Fresno	Aug. 29	28.20	28.33	.50	.50	11.46	14.00	......	.80	.50	3.82
No. 1553.	Paso Robles	Oct. 6	25.90	......	.43	......	......	......	......	......	......	......
No. 1600.	Cupertino	Oct. 20	25.20	24.64	.77	.45	9.99	12.46	.440	......	.70	3.05
1892—No. 1643.	Paso Robles	Sept. 13	24.14	......	.76	......	......	......	......	......	......	......
No. 1703.	Tulare	Sept. 27	24.35	......	.41	......	......	......	......	......	......	......
1893—No. 1830.	Amador station	Sept. 7	20.40	......	.89	.22	......	......	.461	......	......	......
No. 1913.	Paso Robles	Oct. 4	24.80	23.61	.66	.68	9.63	12.00	.285	.70	.43	2.80
No. 1976.	Tulare	Oct. 4	27.35	......	.38	.31	......	......	......	......	......	......
No. 2130.	Cupertino	Nov. 1	25.20	......	.88	......	......	......	.265	......	......	......
1894—No. 2175.	Amador station	Sept. 24	23.70	......	.68	......	......	......	......	......	......	......
No. 2318.	Tulare	Oct. 15	24.80	......	.41	......	......	......	......	......	......	......

COLOR READINGS.

FRESA.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1890—No. 1327.	Cupertino	......	......	......	......	......	......
1891—No. 1469.	Fresno	24.0 4VR+Y	17.4 4VR+Y	11.9 1R+Y	11.1 1R+Y	10.4 1R+Y	10.4 3R+Y
No. 1600.	Cupertino	78.4 5VR	37.0 R	37.0 R-1R	30.5 1R	......	......
1893—No. 1830.	Amador station	33.9 R	33.1 3VR	......	......	......	......
No. 1913.	Paso Robles	28.6 4VR	33.3 3VR	19.5 R	18.3 R	17.5 1R	10.6 3R
No. 2130.	Cupertino	42.1 5VR	......	......	......	......	......

RECORD OF TREATMENT.

No. 1327. *Fresa*, from Cupertino. Received October 13, 1890, in good condition. The must showed 23.9% of solid contents by spindle and 0.94% of acid. There were 191.5 lbs. crushed. The temperature at crushing was 65°, and the maximum reached was 92°, on the fourth day. On the fifth day the wine was still a little sweet, and was drawn off on the sixth.

At three weeks the wine was clear and showed very high acid and astringency. At two months, when the wine was racked for the second time, the lees were sound. At three months the lees showed a few short filaments, and the wine was pasteurized. When pasteurized it was bright, with good, deep color, marked but not delicate aroma and flavor, high astringency, full acid, good body and alcohol. It was a good, solid wine, but a little rough and coarse. Two months after pasteurizing it was bright and developing, but rough, heavy, and extremely astringent. At fifteen months it was in good order, of deep garnet color, with some bouquet, good flavor, and clean taste. It was much smoother and nearly mature. At seventeen months it was racked for the fifth time, and part bottled; at twenty-three months the rest was bottled. At three years and three months both samples were in excellent condition, of good color and body, well flavored, and with little bouquet; the second bottling was smoother than the first, and generally more pleasing.

No. 1469. *Fresa*, from Fresno. Received August 31, 1891, in fair condition, a little dried. The must showed 28.2% of solid contents by spindle and 0.50% of acid. There were 44.75 lbs. crushed. The temperature at crushing was 70°, and the maximum reached was 81°, on the fourth day. The wine was drawn off on the seventh day while still a little sweet.

At two weeks the wine was cloudy and still slightly sweet, but at one month it was clear and almost dry. At six weeks it was bright, with good color, full flavor and aroma, clean taste, and high astringency—a very promising wine. At three months it was racked for the second time, and an examination of the lees showed them to be sound. At this time it was clear, sound, and good, but still had a trace of sweetness. At five months it was still very rough, but clean-tasting and fruity. The lees were sound, and at seven months the wine was smoother and much improved; it was a rich, fruity wine, and had kept remarkably well for such a small sample (two gallons). The sample being so small, it was bottled at this date. At three years and a half the bottled wine was clear, but had made a heavy deposit; it was a very good, clean-tasting wine, with some flavor and bouquet, altogether one of the best table-wines made from Fresa, but was bottled too soon.

No. 1553. *Fresa*, from Paso Robles station. Received October 8, 1891, in good condition. The bunches were small, the berries of medium size and mature. The must showed 25.9% of solid contents by spindle and 0.43% of acid. Only a sample was received for must analysis.

No. 1600. *Fresa*, from Cupertino. Received October 21, 1891, in fair condition, with many small berries and also half-dried ones. The must showed 25.2% of solid contents by spindle and 0.77% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 81°, on the third day. The wine was dry on the fifth day, when it was drawn off.

In one month the wine was clear and of good quality, except that the odor was not good. At four months it was bright, well defecated, of good quality, but very astringent; the lees were sound and the wine was racked for the second time. It remained bright and sound, but was still very rough when racked for the third time at ten months. At fifteen months it was in good order, with somewhat coarse but not disagreeable odor, and the special flavor of the Fresa very pronounced. It was still very rough and not mature, but was bottled, as the quantity was too small to keep longer. At three years and four months the bottled wine was bright—an extremely rich, full wine, but rather coarse and too heavy and solid to be used alone. It had evidently been bottled before it was mature.

No. 1643. *Fresa*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 24.14% of solid contents by spindle and 0.76% of acid.

No. 1708. *Fresa*, from Tulare station. A sample for must analysis was received September 29, 1892, in fair condition. The must showed 24.34% of solid contents by spindle and 0.41% of acid.

No. 1830. *Fresa*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition, but not quite mature. The bunches were small, rounded, and well filled; the berries were small and of reddish color. The must showed 20.4% of solid contents by spindle and 0.89% of acid.

No. 1913. *Fresa*, from Paso Robles station. Received October 6, 1893, in good condition. The bunches and berries were small, but with good characteristic flavor. The must showed 24.8% of solid contents by spindle and 0.66% of acid. The grapes came from long-pruned vines growing on sandy soil, and were produced at the rate of about three tons per acre. There were 207 lbs. crushed. The temperature of the must at crushing was 63°, and the maximum, reached the fourth day, was 91°. The wine was not quite dry when it was drawn off on the sixth day.

In three weeks the wine was nearly clear, but very rough. At six weeks it was clear, of good flavor, and with a slight sweetness. At four months it was bright, quite dry, with some bouquet, good flavor, medium acid, high astringency—a very promising wine. At this time it was racked for the second time. Three months later it was still very rough, but showed excellent keeping qualities. At sixteen months it was in good order, with marked and characteristic aroma and flavor—a full, rich wine, but lacking in delicacy. An examination of the lees showed them to be perfectly sound. A month later the wine was racked and part put in bottle.

No. 1976. *Fresa*, from Tulare station. A sample for must analysis was received October 6, 1893, in good condition. The bunches were very small, short, cylindrical, close; the berries were under medium in size, round, astringent, juicy, with very thick, tough skin, overripe, and much shriveled. The must showed 27.45% of solid contents by spindle and 0.38% of acid. The vines from which this sample came were growing in alkali soil, pruned half-long, and bore at the rate of about four tons to the acre.

No. 2130. *Fresa*, from Cupertino. A sample for must analysis was received November 1, 1893, in good condition. The bunches were of medium size, conico-cylindrical, compact, with small shoulders; the berries were crisp, pulpy, with thick but tender skin, high acid, but mature. The must showed 25.2% of solid contents by spindle and 0.88% of acid.

MORETTO.

Synonyms: Croetto; Lambrusca.

Description.—Vigorous and productive, with strong, somewhat erect canes; leaves large, somewhat downy below, of irregular shape, with or without sinuses, teeth short, veins reddish; bunches small to over-medium, close, short cylindrical, occasionally winged; berries over the average in size, round, thick-skinned, firm, juicy, with neutral flavor.

This variety is extensively cultivated on the plains of Alexandria, in northwestern Italy. It is valued on account of its fertility and its resistance to spring frosts. It is a good, healthy vine, accommodating itself to almost any soil or exposure. Its wine is not considered of high quality. Contrary to the results in Italy, the Moretto, as grown at the stations, has shown itself a poor bearer. The wine has always been unsatisfactory and of very poor keeping qualities. It is, therefore, a variety which cannot at present be recommended for any locality. There are several variations of this variety which are at present being tested; it is, therefore, possible that one of these may prove as satisfactory as they have done in Italy.

Analyses of Musts and Wines.

MORETTO.		Date of Picking	MUST.				WINE.
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Tannin
1892—No. 1633.	Tulare	Sept. 4	24.01	......	.62	......	....
1893—No. 1852.	Amador station	Sept. 13	19.70	......	.77	......	.208
No. 1889.	Tulare	Sept. 1	22.40	21.22	.38	.59	.224
No. 1906.	Tulare	Oct. 2	23.25	20.24	.75	.32	....
No. 1926.	Paso Robles	Oct. 12	24.60	23.32	.43	.35	.214
1894—No. 2177.	Amador station	Sept. 24	24.70	......	.56	......	....
No. 2215.	Paso Robles	Sept. 28	22.80	......	.68	......	....
No. 2319.	Tulare	Oct. 15	26.30	......	.53	......	....

Record of Treatment.

No. 1633. *Moretto*, from Tulare station. A sample for must analysis was received September 6, 1892, in good condition. The must showed 24.01% of solid contents by spindle and 0.62% of acid.

No. 1852. *Moretto*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches were of medium size, very compact; the berries of medium size, thick-skinned, fleshy, fairly well colored, and with some flavor. The must showed 19.7% of solid contents by spindle and 0.77% of acid.

No. 1889. *Moretto*, from Tulare station. A sample for must analysis was received September 2, 1893, in good condition. The bunches were very small, short-cylindrical, not shouldered, but occasionally with a small wing; the berries of good size, round, close together but not compressed, thick-skinned, firm but juicy, mature, but with little flavor. The must showed 22.4% of solid contents by spindle and 0.38% of acid.

No. 1906. *Moretto*, from Tulare station. Received October 2, 1893, in good condition. The bunches were small and close; the berries of over average size, very sweet. The grapes were very thick-skinned, and some of them were dry. The must showed 23.25% of solid contents by spindle and 0.75% of acid. The temperature of the grapes at crushing was 70°, and the maximum, reached on the third day, was 90°. The wine was nearly dry on the fifth day, when it was pressed.

The wine was rough and sharply acid. It remained cloudy for a long time, and never became clean-tasting. It was racked several times, and finally became bright, but was flat and unpleasing. It did not keep well, and was altogether a very unsatisfactory wine.

No. 1926. *Moretto*, from Paso Robles station. A sample for must analysis was received October 12, 1893, in good condition. The bunches were of good size, compact, and shouldered; the berries of medium size, well colored, very sweet, and commencing to dry up. The must showed 24.6% of solid contents by spindle and 0.43% of acid.

No. 2136. *Croetto*, from Cupertino. A sample for must analysis was received November 7, 1893, in good condition. The bunches were small, close, abruptly conical; berries small, round, crisp and juicy, with thick skin. The grapes were very sweet and some of them were dry. The must showed 24.7% of solid contents by spindle and 0.68% of acid.

FAVORITA.

This variety is cultivated to a limited extent in Piedmont at Rivoli. Judging by the one sample received from Cupertino it possesses in a high degree the characteristics of the North Italian grapes.

Record of Treatment.

No. 2123. *Favorita*, from Cupertino. A sample for must analysis and color test was received November 7, 1893, in good condition. The bunches were of medium size, conical, sometimes elongated, loose, and with wings, on slender peduncles; berries of medium size, round, crisp, with thin but tough skin, on very slender pedicels. The grapes were ripe, but very acid. The must showed 24.8% of solid contents by spindle and 1.04% of acid.

TADONE.

Synonyms: Tadon Nero; Cari; Carola.

Description.—Leaves thick, five-lobed, coarsely toothed, hairy below; bunches large, long conico-cylindrical, well filled, on long, slender peduncles; berries of medium size, round, on slender pedicels, without special flavor. The grapes ripen rather late and the vine requires long-pruning.

The grapes are grown to a limited extent in several parts of Piedmont, where they are used both for wine-making and for the table. They give an alcoholic wine with good color.

RECORD OF TREATMENT.

No. 2106. *Tadone*, from Cupertino. A sample for must analysis was received November 7, 1893, in good condition. The bunches were of medium size, variable in shape (conical, conico-cylindrical, or double), on slender, herbaceous peduncles, well filled but not compact; berries medium to small, round, juicy and rather soft, with thick but tender skin, pedicels slender; flavor not marked, but sweet and with good acid. The must showed 23.1% of solid contents by spindle and 0.94% of acid.

NEIRETTA.

Synonyms: Costiole; Fresa di Nizza.

Description.—Vine vigorous and prolific; leaves large, smooth above, woolly below, very slightly lobed; bunches large, conical, winged, close; berries medium in size, round, thick-skinned, and ripening late.

This variety is cultivated largely in Piedmont, especially in the neighborhood of Saluzzo. It is valued on account of its vigor and heavy bearing. It produces a fair and well-colored wine, but not of high quality or of very good keeping qualities. It does well with short-pruning, especially when the vine is trained on trellis or wires.

RECORD OF TREATMENT.

No. 2135. *Neiretta*, from Cupertino. A sample for must analysis was received November 7, 1893, in good condition. The bunches were of medium size, conical, close, with a small wing; berries medium to small, round, soft, juicy, thick-skinned, mature, and very fresh-tasting. The must showed 22.4% of solid contents by spindle and 0.68% of acid.

REFOSCO.

(See Vit. Rept. 1883-85, p. 93; 1885-86, p. 78; 1887-89, p. 155.)

Synonyms: Raboso; Crabb's Black Burgundy; "Petit Pinot" of some.

The identity of Refosco and Crabb's Black Burgundy may be considered as established; their respective modes of growth and the composition of their respective wines are indistinguishable. They are, therefore, treated here under one head, and the analyses of their wines appear in the same table. The wine, though of the same general character as that of most of the Piedmontese grapes which have been tried in California, is less rough and develops more quickly. The average composition of the must and wine, according to analyses made at the station for a series of years, has shown:

	Solid Contents by Spindle.	Acid.	Tannin.
From Cupertino	24.35%	.50%	.282%
From Mission San José	24.25	.64	.248
From San Joaquin Valley	22.46	.50	.276
From Paso Robles	20.98	.60	.218
From Sonoma	25.90	.45	.257

This shows (except at Paso Robles where the vines are young) good sugar contents and sufficient but not excessive acid; the tannin also is full, but not, as a rule, enough to make the wine excessively rough. The wine has always been full-bodied and with excellent color. It is one of the vines which are most promising for the production of dry red wines in districts resembling the lower San Joaquin Valley. Even at Tulare, where the production of a sufficiently colored wine is exceptionally difficult, it has always given good color and occasionally enough to make it valuable for blending with wines lacking in color.

ANALYSES OF MUSTS AND WINES.

REFOSCO.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At 6 to 8 Months	
1890—No. 1287 (C. B. B.). Cupertino	Oct. 1	23.90	......	.55	.27	......	......	......	......	......	......
No. 1316. Mission San José	Oct. 8	27.55	......	.71	......	......	......	......	......	......	......
No. 1318 (C. B. B.). Cupertino	Oct. 11	25.20	......	.62	.34	10.81	13.27	.244	.66	.42	2.78
No. 1343 (C. B. B.). Mission San José	Oct. 11	26.50	......	.63	.22	10.81	13.27	.264	......	.45	3.32
No. 1390. Cupertino	Oct. 18	24.12	......	.55	......	......	......	......	......	......	......
No. 1416. Cupertino	Oct. 28	29.50	......	1.06	.28	11.77	14.40	.363	1.12	.54	......
1891—No. 1498 (C. B. B.). Paso Robles	Sept. 13	19.30	18.30	.47	.31	7.78	9.73	.170	.46	.30	2.80
No. 1516 (C. B. B.). Mission San José	Oct. 1	24.45	24.53	.74	......	9.70	12.09	.220	.75	.35	3.04
No. 1526 (C. B. B.). Asti, Sonoma County	Oct. 5	25.30	24.12	.39	.33	10.26	12.77	.294	.55	.41	2.95
No. 1584. Mission San José	Oct. 13	24.45	22.67	.50	......	9.63	12.00	.220	.48	.70	3.45
1892—No. 1615 (C. B. B.). Tulare	Aug. 26	21.50	18.58	.48	.30	7.92	9.90	.270	.43	.39	3.05
No. 1650 (C. B. B.). Paso Robles	Sept. 13	21.75	......	.75	......	......	......	......	......	......	......
No. 1707 (C. B. B.). Mission San José	Oct. 4	22.80	22.05	.67	.29	8.98	11.18	.229	.63	.49	2.85
No. 1785. Mission San José	Oct. 19	23.50	......	.57	......	9.05	11.27	.198	.65	.44	2.80
1893—No. 1884 (C. B. B.). Paso Robles	Sept. 19	21.90	19.89	.58	.28	7.92	9.90	.266	.60	.58	2.85
No. 1930 (C. B. B.). Tulare	Oct. 12	22.85	21.47	.41	.49	8.84	11.00	.268	.49	.42	2.60
No. 1949. Mission San José	Oct. 12	23.70	......	.63	......	......	......	.358	......	......	......
No. 2063. Cupertino	Oct. 29	26.50	......	.43	......	......	......	.323	......	......	......
No. 2107 (C. B. B.). Cupertino	Nov. 5	25.90	......	.42	......	......	......	.425	......	......	......
No. 2117. Cupertino	Nov. 5	26.30	......	1.07	......	......	......	.432	......	......	......
1894—No. 2171 (C. B. B.). Tulare	Sept. 24	24.00	23.42	.41	......	9.12	11.36	.291	.40	.51	3.10
No. 2268. Mission San José	Oct. 5	22.40	......	.47	......	......	......	.173	......	......	......
No. 2302. Mission San José	Oct. 12	23.10	......	.43	......	......	......	......	......	......	......

COLOR READINGS.

REFOSCO.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1890—No. 1318.	Cupertino														
No. 1343.*	Mission San José	46.5	1VR												
No. 1416.	Cupertino														
1891—No. 1496.	Paso Robles	46.5	1VR	14.1	4VR	14.1	5VR	13.2	5VR	7.7	3R	8.3	3R		
No. 1516.	Mission San José	166.0	1VR	64.5	1VR	26.5	5VR	23.9	5VR	18.0	R	15.5	1R		
No. 1584.	Mission San José	160.0	VR	44.0	1VR	49.4	2VR	50.0	3VR	34.2	3VR				
1892—No. 1615.	Tulare	21.0	3VR	12.5	4VR	9.8	1R	9.7	3R	8.7	2R	8.3	2R	7.6	2R
No. 1707.	Mission San José	174.0	VR	75.5	1VR	74.2	2VR	62.0	2VR	43.9	2VR	36.7	2-3VR		
No. 1785.†	Mission San José	105.0	VR	71.6	2VR	42.5	4VR	26.0	5VR	24.4	5VR				
1893—No. 1884.	Paso Robles	90.9	VR	54.1	VR	50.6	1VR	34.8	1VR	29.6	1VR	24.4	2VR		
No. 1930.	Tulare	60.6	VR	30.3	1VR	17.2	2VR	17.8	3VR	17.6	3VR	11.6	5VR		
No. 1949.	Mission San José	83.3	VR												
No. 2053.	Cupertino	52.0	2VR												
No. 2107.	Cupertino	74.2	VR-1VR												
No. 2117.	Cupertino	160.0	1-2VR												
1894—No. 2171.	Tulare	42.1	1-2VR	31.7	1VR	31.7	1VR	24.4	3VR						
No. 2268.	Mission San José	46.0	VR												

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* Blend.

† Blend of Refosco and Marzemino.

RECORD OF TREATMENT.

No. 1287. *Refosco*, from Cupertino. Received October 3, 1890, in bad condition; the bunches showed much coulure. The grapes were ripe, but too few for wine. The must showed 23.9% of solid contents by spindle and 0.55% of acid.

No. 1316. *Refosco*, from Mission San José. Received October 10, 1890, in a much bruised condition. The sample was small and was fermented as a color test. The must showed 27.55% of solid contents and 0.71% of acid.

No. 1318. *Refosco*, from Cupertino. Received October 13, 1890, in rather poor condition. The must showed 25.2% of solid contents by spindle and 0.62% of acid. Two hundred pounds of grapes were crushed, commenced to ferment at a temperature of 65°, and reached a maximum of 92° on the fourth day. The wine was dry on the fifth day, and was pressed on the sixth.

The wine remained turbid and fermented slowly for a month. In two months it was clear, but had a slightly suspicious odor, and was pasteurized at 160°. An examination of the lees showed some filaments. The wine at this time was smooth, of low acid and full astringency, generally of good quality but for slight lactic taint. The wine after this improved, but never quite lost its disagreeable odor, and at fifteen months was bright and of good color, showed good qualities, but also some volatile acid. At seventeen months it was bottled, but did not keep well.

No. 1343. *Refosco*, from Mission San José. Received October 14, 1890, in poor condition, but mature. The must showed 25.2% of solid contents by spindle and 0.63% of acid. The grapes were fermented with No. 1344, an unknown red grape from Mission San José. The temperature of the must at crushing was 65°, and the maximum reached was 96°, on the fourth day. On the fifth day the wine was nearly dry, and was drawn off on the sixth.

At the end of a month the wine was cloudy and still a little sweet. In two months it was clear, smooth, clean-tasting, with some flavor, aroma, and full astringency; it still contained a little sugar. At the first examination the lees were sound, but at four months they showed a few filaments, so the wine was pasteurized. At this date the wine was clear, with a little flavor and bouquet, but a slight moldy taste, and altogether not of high quality. At seven months it had improved, and was smooth, clear, and heavy-bodied. At fifteen months it was clear, of good color, full acid, little flavor, mature, and of fair quality. At seventeen months it was racked for the fourth time and part of it put in glass; the remainder was bottled at twenty-two months, but none of it improved in bottle.

No. 1390. *Refosco*, from Cupertino. A sample for must analysis was received October 21, 1890, in fair condition, somewhat overripe. The must showed 24.12% of solid contents by spindle and 0.55% of acid.

No. 1416. *Refosco*, from Cupertino. Received October 30, 1890, in fair condition. The must showed 29.5% of solid contents by spindle and 1.06% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 82°, on the fourth day. The wine was drawn off on the sixth day, while still very sweet.

The wine soon became quite clear, but remained very sweet. The wine never became dry, but remained clear and sound, and showed no injurious ferments in the lees. At three months the wine was clear, clean-tasting, but with a burnt odor.

No. 1496. *Refosco*, from Paso Robles station. Received September 16, 1891, in good condition. The bunches were rather large and loose, with small grapes, not quite mature. The must showed 19.3% of solid contents by spindle and 0.47% of acid. The temperature of the must at crushing was 67°, and the maximum reached was 81°, on the third day. The wine was drawn off on the third day, while still a little sweet.

In three weeks the wine was quite dry and nearly clear. At two months it was clear, very rough, and without much flavor. Tastings at three and at four months showed gradual improvement and the development of some bouquet. The lees showed no bad ferments at first, but at six months they were infested with what was apparently a species of *Mucor*, and the wine had become flat and generally deteriorated. At seven months the wine was racked for the third time. At fourteen months it had improved and was bright, but the odor was still not good. At this time it was mature and was put in glass. At three years and a half the bottled wine was tasted and found to be bright and without deposit, not quite clean-tasting, with little bouquet, but good flavor. The wine showed good qualities, but was not alcoholic enough to be a good keeper.

No. 1516. *Refosco*, from Mission San José. Received October 1, 1891, in good condition. There were 106 pounds crushed, and the must showed 24.45% of solid contents by spindle and 0.74% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 87°, on the fourth day. On the sixth day the wine was drawn off nearly dry.

At one month the wine was clear, with good aroma, clean taste, and full acid. At six weeks the wine was racked and put in the cellar; the lees were sound, but showed some *S. pastorianus*. At three months the wine was clear, but tasted a little flat, and, as the lees showed some filaments, it was pasteurized. Two months after pasteurizing the wine was clear, much improved—a fair wine, of good acid and body. It was racked twice after pasteurizing, and at ten months part was put in bottle. At sixteen months the rest was bottled. At three years and a half, the wine first bottled was sound, but very raw. The later bottling was bright and of good flavor and a little bouquet—not a fine wine, but a good ordinary wine, with full acid and astringency.

No. 1584. *Refosco*, from Mission San José. Received October 16, 1891, in fair condition. Only 37 lbs. of grapes were crushed. The must showed 24.45% of solid contents by spindle, and 0.50% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 81°, on the third day. The wine was drawn off on the fourth day, dry.

At one month the wine was clear, but tasted moldy. At four months it was racked for the second time, and the lees were sound; the taste had not improved, and was slightly bitter. At five months the lees showed a little "graisse," but at seven months the wine had improved, and the taste of mold had almost disappeared. On account of the smallness of the sample (two gallons) the wine was bottled at seven months. Three years after bottling the wine was bright, of good color, high bouquet, and good flavor, perfectly sound, but with somewhat harsh acid, and not quite fresh-tasting. It was, however, remarkably well kept, considering the smallness of the original sample.

No. 1615. *Refosco*, from Tulare station. Received August 29, 1892, in very good condition, mature, and with a few half-dried grapes. There were 290.5 lbs. crushed and put in the fermenting-vat at a temperature of 65°. The must showed 21.5% of solid contents by spindle and 0.48% of acid. The maximum temperature reached was 95°, on the sixth day. On the seventh day the wine was drawn off dry.

At one month the wine was very clear, rough, clean-tasting, and perfectly dry. At four months it was bright, with rich aroma and flavor, medium acid, and high astringency. At six months it was racked for the second time and was in good condition, and retained its good quality. Tastings at nine, eleven, and sixteen months showed gradual improvement and development. At the last date it was bright, nearly mature and one of the best of the Tulare wines. Four months later the wine was bottled. At two years and a half the wine in bottle was bright, with sufficient color, some bouquet and flavor, very clean-tasting, with low acid, high astringency; altogether a very creditable table wine alone, but would make an excellent blend with some acid, highly flavored wine of Claret type. This wine was distinguished particularly from most Tulare wines by its exceptionally clean after-taste; it was distinctly a wine "che finisce bene."

No. 1650. *Refosco*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 21.75% of solid contents by spindle and 0.75% of acid.

No. 1707. *Refosco*, from Mission San José. Received October 5, 1892, in fair condition. The must showed 22.8% of solid contents by spindle and 0.67% of acid. The temperature of the 160 lbs. crushed was 69°, and the maximum reached was 92°, on the third day. The wine was dry on the fourth day, when it was drawn off.

At three weeks the wine was clear and dry, and at one month was racked and taken to the cellar. At three months the wine was bright, with good aroma and flavor, high acid and astringency. The wine remained in good condition, and at six months was racked for the second time. At eight months it was bright and a very good wine. Tastings at ten and fourteen months showed that it remained in good condition. At eighteen months it tasted mature and was bottled.

No. 1785. *Refosco*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 23.5% of solid contents by spindle and 0.57% of acid. The grapes were fermented with No. 1786, Marzemino, in the proportion of Refosco 47 lbs. and Marzemino 14.5 lbs. The temperature of the grapes at crushing was 64°, and the maximum reached was 81°, on the fourth day. The wine was drawn off on the fifth day.

At one month the wine was clear and was racked and taken to the cellar. At three months it was bright, with good bouquet and flavor, medium acid, and full astringency—a clean-tasting and generally successful blend. At five months it was racked for the third time, and at seven months it had developed well and was an excellent, clean-tasting wine, considering the smallness of the sample. At thirteen months it was still good and mature, but a little *eventé*. A month later it was bottled.

No. 1884. *Refosco*, from Paso Robles station. Received September 21, 1893, in good condition. The bunches were of medium size, very loose, but not coulured; the berries were also of medium size, with rather soft, juicy flesh, sweet, mature, but without much flavor. The must showed 21.9% of solid contents by spindle and 0.58% of acid. There were 130 lbs. of grapes crushed. The temperature at crushing was 68°, and the maximum reached was 87°, on the third day. The wine was nearly dry on the fourth day, and was drawn off on the fifth.

At three weeks the wine was nearly clear, but had a slightly moldy taste; it was racked and taken to the cellar. At four months it was bright, with some bouquet and flavor, high acid and tannin—a fresh-tasting and agreeable but rough wine. It was racked for the second time at four months, and at eight months it was a good wine, but tasted a little green. At eleven months it had improved, and had developed some bouquet, but was not mature. An examination of the lees showed *S. pastorianus*. At seventeen months the wine was in good order—a good, sound wine, with some flavor and bouquet, good color; its chief faults were a slight greenness and a faint after-taste of mold. A month later it was racked, and a part put in bottle.

No. 1930. *Refosco,* from Tulare station. Received October 13, 1893, in good condition. The bunches were large, loose, winged; the berries of medium size, very ripe, sweet, and with little acid. The temperature of the 362 lbs. crushed was 67°, and the maximum reached was 96°, on the third day. On the fourth day the wine was dry, and was drawn off on the fifth. The must at crushing showed 22.85% of solid contents by spindle and 0.41% of acid.

At one month the wine was clear, very astringent, of good flavor, and had still a slight sweetness. At this time it was racked and taken to the cellar. At four months it was bright, dry, with some bouquet, good flavor, high astringency, and clean taste. It was racked again at five months, and at seven months it retained its good qualities and was, perhaps, the best of the Tulare wines. At ten months the lees showed a few filaments, but the wine was quite bright and tasted perfectly sound; it was smooth and agreeable, with some bouquet and fair color. It was racked, and continued to improve. At sixteen months it was a full and agreeable wine, not quite mature. Two months later it was racked, and part of it put in bottle.

No. 1949. *Refosco,* from Mission San José. A sample for must analysis was received October 14, 1893, in poor condition. The must showed 23.7% of solid contents by spindle and 0.63% of acid.

No. 2053. *Refosco,* from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, conical, well filled; the berries oval, fleshy, very sweet, commencing to dry, tasted a little cooked.

No. 2107. *Refosco,* from Cupertino. A sample for must analysis was received November 5, 1893, in good condition. The bunches were small, conico-cylindrical, sometimes branched, well filled, but not compact; the berries were of under-medium size, slightly elongated, crisp, with thin skin, and mature. The must showed 25.9% of solid contents by spindle and 0.42% of acid.

No. 2117. *Refosco,* from Cupertino. A sample for must analysis was received November 5, 1893, in good condition. The bunches were small, conical, slightly shouldered, well filled, not compact, on long, woody, colored peduncles; the berries were small, nearly round, on slender pedicels. This variety was very ripe and commencing to dry up; it is very distinct from No. 2107.

MARZEMINO.

(See Vit. Rept. 1887–89, p. 164.)

This variety has proved one of the poorest bearers among the Italian varieties. It is a good grower and does not suffer from coulure, but it has failed to bear at any of the stations where it has been tested. It attains a lower percentage of both sugar and acid than most of its congeners, averaging at Cupertino 22.7% of sugar and 0.67% of acid, and at Mission San José 22.77% of sugar and 0.63% of acid. It gives a wine of good color and very high tannin, but not possessed of high enough quality to offset its failure to bear. At Fresno the must has averaged 24.76% of sugar and 0.40% of acid.

ANALYSES OF MUSTS AND WINES.

MARZEMINO.		Date of Picking	MUST.				WINE.	
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Tannin	Total Acid as Tartaric at Pressing.
1890—No. 1231.	Fresno	Aug. 23	23.41	23.61	.38	.33	......	......
No. 1293.	Cupertino	Oct. 1	21.10	......	.89	,28	......	......
No. 1358.	Mission San José	Oct. 12	23.05	......	.71	......	......	......
1891—No. 1470.	Fresno	Aug. 29	26.10	......	.41	......	......	......
1892—No. 1786.	Mission San José	Oct. 18	22.80	......	.61	......	......	......
1893—No. 1997.	Mission San José	Oct. 19	22.60	......	.71	......	.413	.69
No. 2119.	Cupertino	Nov. 5	21.50	......	.69	......	.355	.68
1894—No. 2243.	Mission San José	Oct. 5	19.50	......	.67	......	......	......

COLOR READINGS.

MARZEMINO.	At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1891—No. 1470. Fresno	69.0 2VR	27.0 4VR	28.6 4VR	34.8 5VR	22.0 R	23.0 R-1R
1893—No. 1997. Mission San José	125.0 VR					
No. 2119. Cupertino	105.0 1VR					

RECORD OF TREATMENT.

No. 1231. *Marzemino*, from Margherita Vineyard, Fresno. A sample for must analysis arrived August 25, 1890, in excellent condition, and mature. The must showed 23.21% of solid contents by spindle and 0.38% of acid.

No. 1293. *Marzemino*, from Cupertino. A sample for must analysis was received October 3, 1890, in very good condition. The must showed 21.1% of solid contents by spindle and 0.89% of acid.

No. 1358. *Marzemino*, from Mission San José. A sample for must analysis arrived October 14, 1890, in fair condition, and mature. The must showed 23.05% of solid contents by spindle and 0.71% of acid.

No. 1470. *Marzemino*, from Margherita Vineyard, Fresno. A sample for must analysis and color test was received August 31, 1891, in good condition. The must showed 26.1% of solid contents by spindle and 0.41% of acid.

No. 1786. *Marzemino*, from Mission San José. A sample for must analysis and color test was received October 21, 1892, in poor condition. The must showed 22.8% of solid contents by spindle and 0.61% of acid.

No. 1997. *Marzemino*, from Mission San José. A sample for must analysis and for color and tannin tests was received October 19, 1893, in good condition, and mature. The bunches were over medium in size, pyramidal to conical, heavily winged or shouldered, well filled, but not compact; the berries were of medium size, round, on very slender pedicels, and had plenty of acid. The must showed 22.6% of solid contents by spindle and 0.71% of acid.

No. 2119. *Marzemino*, from Cupertino. A sample for must analysis and color and tannin tests was received November 5, 1893, in good condition. The bunches were of medium size, long cylindrical, close; the berries of medium size, round, commencing to shrivel, soft, and with thick skin. The must showed 21.5% of solid contents by spindle and 0.69% of acid.

LAGRAIN.

(See Vit. Rept. 1887–89, p. 247.)

This variety makes a heavy-bodied, astringent wine, of good color. At Tulare it has surpassed all other varieties in the matter of color, being superior to the Petit Bouschet, and, though having less than the St. Macaire to start with, it is much more stable and of better tint. This quality of retaining its color, which it has in spite of its somewhat low acid, is invaluable for Tulare; it would make an excellent blend for coloring purposes. The average composition of the must at Tulare has been 25.95% of sugar and 0.42% of acid, and the vine has borne between three and four tons per acre. At the Bay region stations the vine has not borne well, and as a coloring grape is surpassed there by many others which are better bearers.

ANALYSES OF MUSTS AND WINES.

LAGRAIN.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1233.	Fresno	Aug. 23	25.10	24.86	.44	.38						
No. 1411.	Cupertino	Oct. 28	22.60		.51							
No. 1419.	Mission San José	Oct. 29	25.65		.72	.20	12.62	15.50	.313	.84	.55	3.82
1892—No. 1693.	Tulare	Sept. 26	25.65		.39							
No. 1788.	Mission San José	Oct. 18	21.30		.64							
1893—No. 2002.	Tulare	Oct. 22	25.40	24.86	.43	.45	9.92	12.36	.272	.55	.85	3.70
No. 2126.	Cupertino	Nov. 5	24.10		.68				.419			
1894—No. 2258.	Mission San José	Oct. 5	22.20		.66				.342			
No. 2320.	Tulare	Oct. 15	26.70		.43							

COLOR READINGS.

LAGRAIN.		At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1890—No. 1419.	Mission San José	149.0 VR	74.1 VR	60.6 4VR	49.4 3VR		
1893—No. 2002.	Tulare	95.2 VR	60.6 1VR	60.6 1VR	55.5 1VR	52.0 2VR	53.5 3VR
No. 2126.	Cupertino	121.0 1VR					

Record of Treatment.

No. 1233. *Lagrain*, from Fresno. A sample for must analysis arrived August 25, 1890, in good condition but for a few dried grapes; very sweet. The must showed 25.1% of solid contents by spindle and 0.44% of acid.

No. 1411. *Lagrain*, from Cupertino. A sample for must analysis was received October 30, 1890, in good condition, but a little soft and overripe. The must showed 22.6% of solid contents by spindle and 0.51% of acid.

No. 1419. *Lagrain*, from Mission San José. Received October 30, 1890, in good condition and ripe. The must showed 25.65% of solid contents by spindle and 0.72% of acid. Only a small quantity of grapes was received; they were fermented as a color sample.

No. 1693. *Lagrain*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 25.65% of solid contents by spindle and 0.39% of acid.

No. 1788. *Lagrain*, from Mission San José. A sample for must analysis arrived October 21, 1892, in poor condition. The must showed 21.3% of solid contents by spindle and 0.64% of acid.

No. 2002. *Lagrain*, from Tulare station. Received October 23, 1893, in good condition. The bunches were small, irregular, well filled; the berries of medium size, well colored, very sweet, overripe. The must showed 25.4% of solid contents by spindle and 0.43% of acid. The temperature of the must at crushing was 67°, and the maximum reached was 81°, on the second day. The murk was nearly dry on the fourth day, when it was pressed.

Three weeks after pressing the wine was still a little sweet, but clear. It was racked and taken to the cellar. At three months it was bright, full-bodied, clean-tasting, with medium acid and astringency, very promising, but only three gallons in quantity. Three months later it was still bright and had developed some bouquet, but it also acquired some volatile acid. After this it deteriorated, on account of the smallness of the keg.

No. 2126. *Lagrain*, from Cupertino. A sample for must analysis arrived November 7, 1893, in good condition, but commencing to dry up. The bunches were of medium size, conical, winged, loose; the berries small, round, and soft. The must showed 24.1% of solid contents by spindle and 0.68% of acid.

GROS MANSENC.

(See Vit. Rept. 1887–89, p. 66.)

This variety has sometimes, on account of the many qualities they have in common, been confounded with the Tannat, from which, however, it is perfectly distinct. The Mansenc, like the Tannat, is a vigorous grower, a fair to good bearer with long-pruning, and produces a must (where the grapes ripen properly) rich in sugar and acid. At Mission San José the grapes seldom ripen thoroughly, but at Cupertino and in parts of Napa and Sonoma they do better. At Cupertino the average composition of the must has been 24% of sugar and 0.77% of acid; at Mission San José, 22% of sugar and 1.20% of acid; at Tulare and Fresno, 25% of sugar and 0.67% of acid; at the Amador station, 24% of sugar and 1.12% of acid.

The wine is easily fermented and a robust keeper; in its roughness and high acidity it resembles the North Italian varieties. It has very intense color, and where the grapes ripen properly it should be very useful as a blending wine. It is not so astringent as the Tannat, but has more color and acidity, and develops more quickly.

GROS MANSENC.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body
1890—No. 1243.	Fresno	Aug. 26	23.25	22.05	1.15	.40	9.27	11.55	.180	.75	.59	2.95
No. 1277.	Cupertino	Oct. 1	23.25	......	1.20	.31	9.34	11.64	.313	.85	.57	2.82
No. 1339.	Mission San José	Oct. 12	23.30	......	1.25	.17	9.20	11.45	.210	1.09	.62	2.82
1891—No. 1468.	Fresno	Aug. 29	24.35	......	.88	......	9.70	12.09	.200	.75	.55	3.05
No. 1547.	Paso Robles	Oct. 6	21.97	21.00	.81	......	......	......	......	......	......	......
No. 1562.	Mission San José	Oct. 6	20.70	19.54	1.62	......	7.99	10.00	.275	1.32	.95	3.20
1892—No. 1680.	Tulare	Sept. 18	24.35	......	.36	......	......	......	......	......	......	......
No. 1763.	Paso Robles	Oct. 11	23.70	......	.61	......	......	......	......	......	......	......
No. 1766.	Mission San José	Oct. 12	20.20	19.20	1.39	......	7.78	9.73	.242	1.15	1.11	3.20
1893—No. 1833.	Amador station	Sept. 8	23.50	......	1.31	.23	......	......	.393	.91	......	......
No. 1899.	Tulare	Sept. 29	26.10	25.76	.47	.49	9.92	12.36	.294	.50	.51	3.60
No. 2083.	Paso Robles	Nov. 4	23.70	22.67	.68	.29	9.20	11.45	.240	.65	.54	2.85
1894—No. 2198.	Amador station	Sept. 23	24.20	......	.93	......	......	......	......	......	......	......
No. 2204.	Tulare	Sept. 25	26.70	......	.47	......	......	......	......	......	......	......
No. 2344.	Mission San José	Oct. 22	22.60	......	.88	......	......	......	......	......	......	......

COLOR READINGS.

GROS MANSENC.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—No. 1468.	Fresno	43.0	3VR	27.2	3VR	20.5	3VR	21.6	3VR	22.2	3VR	23.0	4VR
No. 1562.	Mission San José	154.0	1VR	120.0	2VR	108.0	3VR	61.0	3VR	85.0	2–3VR	......	......
1892—No. 1766.	Mission San José	166.0	2VR	190.0	2VR	125.0	3VR	108.0	2VR	93.0	2VR	88.8	2VR
1893—No. 1833.	Amador station	83.0	VR	83.0	VR	......	......	......	......	......	......	......	......
No. 1899.	Tulare	75.5	VR	24.4	2VR	26.3	2VR	24.4	3VR	24.1	5VR	20.0	5VR
No. 2083.	Paso Robles	53.5	1–2VR	41.2	1–2VR	32.5	3VR	26.0	3–4VR	19.2	4VR	......	......

RECORD OF TREATMENT.

No. 1243. *Gros Mansenc*, from Margherita Vineyard, Fresno. Received August 26, 1890, in good condition, but very irregular in the degree of ripeness of the bunches. The must showed 23.25% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum attained was 86°, on the third day.. The murk was dry on the fifth day, when it was drawn off.

The wine was long in clearing, and fermented gently for over two months after it was drawn off. At nine weeks it was clear, had a fairly agreeable, but not marked, flavor, full acid and tannin, and good but not very deep color. At four months it was bright and had been racked twice; the lees showed a good deal of lactic germs; this was also slightly perceptible to the taste; on this account the wine was pasteurized. The wine was racked twice more during the year, and gradually improved and became bright, developed a little bouquet, and lost its slight touch of lactic taint. At fourteen months it was bright, vinous, well flavored, possessed of a little bouquet, and, though highly astringent, was almost mature. At eighteen months it was bottled. Two years after bottling the wine was bright and in first-class order, smooth, clean-tasting, of good body and flavor, though neutral; it had become much smoother and had acquired some delicacy in aging.

No. 1277. *Gros Mansenc*, from J. T. Doyle, Cupertino. Received October 2, 1890, in fair condition. The bunches were small and loose, the berries small; the grapes were not mature and still wet with the rain. The must showed 23.25% of solid contents by spindle. The temperature of the must at crushing was 66°, and the highest temperature reached was 89°, on the fourth day. The murk was drawn off on the sixth day.

The wine was rather slow in clearing, but in two months it was bright, of good flavor and aroma, clean taste, good body and alcohol, and high acid and astringency. At four months the wine had been racked twice, and was bright, with good bouquet and, though the lees showed a few lactic ferments, the taste was unaffected. A week later it was pasteurized for safety. Three months after pasteurizing the wine was bright, perfectly sound, and, though still rough, maturing well. At fifteen months it was nearly mature and of very good quality. Some of the wine was bottled at eighteen months and some of it at twenty-six. At three years the wine was tasted, and that first bottled was found to be sound, but not clear, and was raw-tasting; the second bottled was clearer, of good bouquet and flavor, smooth and agreeable, its general quality very good.

No. 1339. *Gros Mansenc*, from Mission San José. Received October 14, 1890, in good condition, but not quite ripe. The must showed 23.3% of solid contents by spindle. The temperature of the grapes at crushing was 66°, and the maximum temperature reached was 94°, on the fourth day. At the end of the fourth day the murk was nearly dry, and was drawn off.

Three weeks after pressing the wine was clear. At six weeks after pressing it showed good bouquet, pleasing flavor, full astringency, very high acid, its general character rough, but promising. At four months it had been racked twice, and was bright, with strong and pleasing bouquet, full flavor, generally improved and smoother, but with extremely high acid. An examination of the lees at five months showed large quantities of *S. pastorianus*. The wine remained bright and sound, and continued to improve up to the age of seventeen months, when some of it was bottled; the rest was bottled at twenty-two months. At three years and three months—twenty-two and seventeen months after bottling, respectively—both samples were tasted. They were both in good order, with high bouquet and full flavor, rather high acid, but clean-tasting and of excellent quality; the second bottling was the smoother.

No. 1468. *Gros Mansenc*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition. The must showed 24.35% of solid contents by spindle. The temperature of the must at starting was 68°, and the highest temperature reached was 84°, on the fourth day. It was somewhat slow in fermenting through, and was pressed on the seventh day while still a little sweet.

Two weeks after pressing the wine was nearly clear and quite dry. It was very rough and highly acid, but improved quickly and soon developed some bouquet. At four months it was racked for the second time; it was bright, with good bouquet and flavor, full acid, rough, but clean-tasting. At six months it had toned down considerably, and was nearing maturity. At nine months it was bright, and, though somewhat lacking in freshness, a good wine. It retained its good qualities, but did not improve much up to seventeen months, when it was bottled. At three years and a half the wine was bright, well flavored, with a little bouquet, of good color and clean taste, and had made no deposit in bottle. Some bottled at twelve months was sound, but not clear, and had made a heavy deposit.

No. 1547. *Gros Mansenc*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition. The grapes were mature, small, in medium-sized bunches. The must showed 21.97% of solid contents by spindle.

No. 1562. *Gros Mansenc*, from Mission San José. Received October 9, 1891, in good condition. The must showed 20.7% of solid contents by spindle. The temperature of the must at starting was 60°, and the highest temperature reached was 90°, on the fourth day. The murk was nearly dry on the fifth day, when it was drawn off.

A month after pressing the wine was clear, possessed of good bouquet and flavor and excessively high acid. At four months an examination of the lees showed much *S. pastorianus.* At five months it was bright, with rich, vinous bouquet and flavor, adequate astringency, but too much acid. It was racked three times during the first ten months, a portion bottled, and at sixteen months was much toned down and nearly mature. At eighteen months part of it was bottled and the remainder racked. At twenty-two months the wine that remained in wood was in excellent condition and of good quality; its only fault was its somewhat excessive acidity. It made an excellent wine for dilution. It was mature and was bottled. At three years and a half the wine bottled at ten months was bright, of good color, high bouquet, good flavor, medium astringency, and extremely high acid—a very good wine, but much too acid to be used alone. The wine bottled at eighteen months and at twenty-two months differed little from the other, but was not quite so full flavored and was clean-tasting.

No. 1680. *Gros Mansenc*, from Tulare station. A sample for must analysis was received September 21, 1892, in good condition. The must showed 24.35% of solid contents by spindle.

No. 1763. *Gros Mansenc*, from Paso Robles station. Received October 14, 1892, in good condition. The must showed 23.7% of solid contents by spindle. The grapes were fermented with No. 1761, Tannat, from Paso Robles.

No. 1766. *Gros Mansenc*, from Mission San José. Received October 15, 1892. The must showed 20.2% of solid contents by spindle. The temperature of the must at crushing was 58°, and the highest temperature reached was 85°, on the fifth day. The murk was dry on the sixth day, and was drawn off.

Three weeks after pressing the wine was clear, very rough, and extremely acid. At three months it was bright, of good body, harsh, and with a moldy taste, due to the bad condition of the grapes when crushed. The wine was racked four times, and improved a little, but never quite lost its moldy taste and retained its harsh acidity. It was bottled at eighteen months.

No. 1833. *Gros Mansenc*, from Amador station. A sample for must analysis was received September 11, 1893, in good condition. The grapes were very small and not quite mature. The must showed 23.5% of solid contents by spindle.

No. 1899. *Gros Mansenc*, from Tulare station. Received September 30, 1893. The grapes arrived in good condition and well matured, but with little flavor. The bunches were small, from loose to compact, the berries of medium size, with rather thick skin and little color. The must showed 26.1% of solid contents by spindle. The temperature of the must at crushing was 66°, and the maximum reached was 82°, on the third day. The murk was dry on the fifth day, and was drawn off.

At one month the wine was nearly clear, smooth, and pleasing, but not perfectly dry. At four months it was clear, of good color, acid, and astringency, but not perfectly clean-tasting. The quantity was rather too small for a fair test. At seven months the wine was sound and in good order, but a little flat.

No. 2083. *Gros Mansenc*, from Paso Robles station. Received November 6, 1893, in fair condition, a few of the grapes moldy. The bunches were of medium size, compact, conical, shouldered; the berries small, juicy, with high acid, and not quite mature. The must showed 23.7% of solid contents by spindle. The temperature of the must at crushing was 62°, and the maximum reached was 83°, on the fourth day. The murk was nearly dry on the fifth day, and was pressed.

In one month from crushing the wine was clear. At three months it was racked for the second time; it was bright, with good bouquet and rich flavor, clean taste, medium astringency, full, pleasant acid, and in general a light, fresh wine of good quality. At six months it had developed well and was a wine of distinctive character and good quality.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF NORTH ITALIAN TYPE—RED.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Nebbiolo.										
1285	Cupertino	1890	22.80		.82	.22					
1364	Cupertino	1890	23.70		.96						
2039	Cupertino	1893	23.70		1.26			.387			
2058	Cupertino	1893	23.30		1.14			.352			
1695	Tulare	1892	22.80		.80						
1700	Tulare	1892	25.40		.41						
1857	Amador station	1893	20.60		1.15						
1858	Amador station	1893	20.20		1.07						
1938	Paso Robles	1893	25.90	24.97	.53	.34		.281			
2277	Asti, Sonoma County	1894	22.20	21.38	.99	.31					
1575	Asti, Sonoma County	1891	26.90	27.65	.45	.28					
	Average, Cupertino		**23.25**		**.89**			**.369**			
	Average, Tulare		**24.10**		**.62**						
	Average, Amador station		**20.40**		**1.11**						
	Barbera.										
1324	Cupertino	1890	27.65		.50						
2040	Cupertino	1893	25.90		1.32			.441			
1445	Tulare	1891	25.65		.77						
1675	Tulare	1892	24.55	25.76	.65	.71	12.18	.124		.56	3.20
1931	Tulare	1893	23.50	21.22	1.03	.41					
2211	Tulare	1894	24.80	23.61	.60		12.50	.204	.65	.52	3.10
1573	Asti, Sonoma County	1891	28.80	28.52	.75	.40	14.20	.265	.85	.52	3.25
2276	Asti, Sonoma County	1894	25.30	24.12	.79						
	Average, Tulare		**25.00**	**24.68**	**.67**	**.71**	**12.34**	**.164**	**.65**	**.54**	**3.15**
	Average, Asti, Sonoma County		**27.05**	**26.32**	**.77**	**.40**	**14.20**	**.265**	**.85**	**.52**	**3.25**

SUMMARY OF ANALYSES OF MUSTS AND WINES OF NORTH ITALIAN TYPE—RED—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Bonarda.										
1362	Cupertino	1890	22.82	....	.72	.22	11.73	.400	.71	.32	2.70
1384	Cupertino	1890	25.20	....	1.02	.90	12.36	.286	....	.60	2.58
1385	Cupertino	1890	24.45	....	1.09	....	....	....	....	....	....
1599	Cupertino	1891	24.80	....	.91	.33	12.36	.356	.83	.83	3.35
2108	Cupertino	1893	25.00	....	.68	....	....	.496	....	....	....
2110	Cupertino	1893	24.80	....	.78	....	....	.253	....	....	....
1869	Paso Robles	1893	22.80	19.89	.45	.41	10.08	.134	.40	.57	2.80
2310	Tulare	1894	26.50	....	.39	....	....	....	....	....	....
	Average, Cupertino	....	**24.52**	....	**.82**	**.48**	**12.15**	**.358**	**.77**	**.58**	**2.88**
	Fresa.										
1327	Cupertino	1890	23.90	....	.94	.21	12.18	.451	.97	.53	3.08
1600	Cupertino	1891	25.20	24.64	.77	.45	12.46	.440	....	.70	3.05
2130	Cupertino	1893	25.20	....	.88	....	....	.265	....	....	....
1469	Fresno	1891	28.20	28.33	.50	.50	14.00	....	.80	.50	3.82
1553	Paso Robles	1891	25.90	....	.43	....	....	....	....	....	....
1643	Paso Robles	1892	24.14	....	.76	....	....	....	....	....	....
1913	Paso Robles	1893	24.80	23.61	.66	.68	12.00	.285	.70	.43	2.80
1703	Tulare	1892	24.35	....	.41	....	....	....	....	....	....
1976	Tulare	1893	27.35	....	.38	.31	....	....	....	....	....
2318	Tulare	1894	24.80	....	.41	....	....	....	....	....	....
1830	Amador station	1893	20.40	....	.89	.22	....	.461	....	....	....
2175	Amador station	1894	23.70	....	.68	....	....	....	....	....	....
	Average, Cupertino	....	**24.77**	**24.64**	**.86**	**.33**	**12.32**	**.385**	**.97**	**.62**	**3.07**
	Average, Paso Robles	....	**24.95**	**23.61**	**.62**	**.68**	**12.00**	**.285**	**.70**	**.43**	**2.80**
	Average, Tulare	....	**23.50**	....	**.40**	**.31**	....	....	....	....	....
	Average, Amador station	....	**22.05**	....	**.78**	**.22**	....	**.461**	....	....	....

	Croetto.										
2136	Cupertino	1893	24.70		.68						
	Moretto.										
1633	Tulare	1892	24.01		.62						
1889	Tulare	1893	22.40	21.22	.38	.59		.224			
1906	Tulare	1893	23.25	20.24	.75	.32					
2319	Tulare	1894	26.30		.53						
1852	Amador station	1893	19.70		.77			.208			
2177	Amador station	1894	24.70		.56						
1926	Paso Robles	1893	24.60	23.32	.43	.35		.214			
2215	Paso Robles	1894	22.80		.68						
	Average, Tulare		**23.74**	**20.73**	**.57**	**.46**		**.224**			
	Average, Amador station		**22.20**		**.66**			**.208**			
	Average, Paso Robles		**23.70**	**23.32**	**.55**	**.35**		**.214**			
	Favorita.										
2123	Cupertino	1893	24.80		1.04						
	Tadone.										
2106	Cupertino	1893	23.10		.94						
	Refosco.										
1287	Cupertino	1890	23.90		.55	.27					
1318	Cupertino	1890	25.20		.62	.34	13.27	.244	.66	.42	2.78
1390	Cupertino	1890	24.12		.55						
1416	Cupertino	1890	29.50		1.06	.28					
2053	Cupertino	1893	26.50		.43			.323			
2107	Cupertino	1893	25.90		.42			.425			
2117	Cupertino	1893	26.30		1.07						
1316	Mission San José	1890	27.55		.71						
1343	Mission San José	1890	26.50		.63	.22					
1516	Mission San José	1891	24.45	24.53	.74		12.09	.220	.75	.35	3.04
1707	Mission San José	1892	22.80	22.05	.67	.29	11.18	.229	.63	.49	2.85
1785	Mission San José	1892	23.50		.57						
1949	Mission San José	1893	23.70		.63			.358			
2268	Mission San José	1894	22.40		.47			.173			
2302	Mission San José	1894	23.10		.43						
1584	Mission San José	1891	24.45	22.67	.50		12.00	.220	.48	.70	3.45
1496	Paso Robles	1891	19.30	18.30	.47	.31	9.73	.170	.46	.30	2.80
1650	Paso Robles	1892	21.75		.75						
1884	Paso Robles	1893	21.90	19.89	.58	.28	9.90	.266	.60	.58	2.85
1526	Asti, Sonoma County	1891	25.30	24.12	.39	.33	12.77	.294	.55	.41	2.95
1615	Tulare	1892	21.50	18.58	.48	.30	9.90	.270	.43	.39	3.05
1930	Tulare	1893	22.85	21.47	.41	.49	11.00	.268	.49	.42	2.66

Summary of Analyses of Musts and Wines of North Italian Type—Red—Continued.

Number	Locality	Vintage of	Must.				Wine.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Refosco—Continued.										
2171	Tulare	1894	24.00	23.42	.41		11.36	.291	.40	.51	3.10
	Average, Cupertino		25.12		.51	.30	13.27	.244	.66	.42	2.78
	Average, Mission San Jose		24.27	23.08	.58	.26	11.76	.240	.62	.51	3.11
	Average, Paso Robles		20.98	19.09	.60	.29	9.81	.218	.53	.44	2.83
	Average, Tulare		22.78	21.16	.47	.39	10.75	.276	.44	.44	2.93
	Neiretta.										
2135	Cupertino	1893	22.40		.68						
	Marzemino.										
1231	Fresno	1890	23.41	23.61	.38	.33					
1470	Fresno	1891	26.10		.41						
1293	Cupertino	1890	21.10		.89	.28					
2119	Cupertino	1893	21.50		.69			.355	.68		
1358	Mission San José	1890	23.05		.71						
1786	Mission San José	1892	22.80		.61						
1997	Mission San José	1893	22.60		.71			.413	.69		
2243	Mission San José	1894	19.50		.67						
	Average, Fresno		24.75	23.61	.39						
	Average, Cupertino		21.30		.79			.355	.68		
	Average, Mission San Jose		21.99		.67			.413	.69		
	Lagrain.										
1233	Fresno	1890	25.10	24.86	.44	.38					
1411	Cupertino	1890	22.60		.51						
2126	Cupertino	1893	24.10		.68			.419			
1419	Mission San José	1890	25.65		.72	.20	15.50	.313	.84	.55	3.82
1788	Mission San José	1892	21.30		.64						
2258	Mission San José	1894	22.20		.66			.342			

1693	Tulare	1892	25.65		.39						
2002	Tulare	1893	25.40	24.86	.43	.45	12.36	.272	.55	.85	3.70
2320	Tulare	1894	26.70		.43						
	Average, Cupertino		**23.35**		**.59**			**.419**			
	Average, Mission San Jose		**23.05**		**.67**	**.20**	**15.50**	**.327**	**.84**	**.55**	**3.82**
	Average, Tulare		**25.91**	**24.86**	**.41**	**.45**	**12.36**	**.272**	**.55**	**.85**	**3.70**
	Gros Mansenc.										
1243	Fresno	1890	23.25	22.05	1.15	.40	11.55	.180	.75	.59	2.95
1468	Fresno	1891	24.35		.88		12.09	.200	.75	.55	3.05
1277	Cupertino	1890	23.25		1.20	.31	11.64	.313	.85	.87	2.82
1339	Mission San José	1890	23.30		1.25	.17	11.45	.210	1.09	.62	2.82
1562	Mission San José	1891	20.70	19.54	1.62		10.00	.275	1.32	.95	3.20
1766	Mission San José	1892	20.20	19.20	1.39		9.73	.242	1.15	1.11	3.20
2344	Mission San José	1894	22.60		.88						
1547	Paso Robles	1891	21.97	21.00	.81						
1763	Paso Robles	1892	23.70		.61						
2083	Paso Robles	1893	23.70	22.67	.68	.29	11.45	.240	.65	.54	2.85
1680	Tulare	1892	24.35		.36						
1899	Tulare	1893	26.10	25.76	.47	.49	12.36	.294	.50	.51	3.60
2204	Tulare	1894	26.70		.47						
1833	Amador station	1893	23.50		1.31	.23		.393	.91		
2198	Amador station	1894	24.20		.93						
	Average, Fresno		**23.80**	**22.05**	**1.02**	**.40**	**11.82**	**.190**	**.75**	**.57**	**3.50**
	Average, Mission San Jose										
	Average, Paso Robles		**23.12**	**21.83**	**.70**	**.29**	**11.45**	**.240**	**.65**	**.54**	**2.85**
	Average, Tulare			**25.76**	**.48**	**.49**	**12.36**	**.294**	**.51**	**.50**	**3.60**
	Average, Amador station										

AUSTRIAN AND HUNGARIAN TYPE—RED.

(See Vit. Rept. 1887-89, p. 230.)

Perhaps the most valuable of the red grapes cultivated in Austria are the Refosco and the Marzemino. These varieties, however, together with Lagrain, are so distinctly congeneric with those which make the distinct type of North Italian grapes, that they are included in the same group.

The four grapes here classed together are somewhat diverse in character, and should be denominated simply a group rather than a type. They agree, however, in being smooth, quick maturing, and of ordinary quality. The wide range of adaptability of the Zinfandel is not characteristic of the other three, which are successful only in certain favorable localities. The famous Kadarkas has, so far, been a failure here, but has given indications that, under favorable conditions, it is capable of yielding a good wine. It should be tried further in the lower coast counties.

KADARKAS.

(See Vit. Rept. 1887-89, p. 245.)

The locality in California, suitable to the Kadarkas, if such a one exists, has not yet been found. It will occasionally make a good wine in the Bay region, but is generally lacking in color, often in tannin and sugar, and sometimes in acid. Altogether it is very unreliable for any locality where it has been yet tested. The fine quality of the wine, however, which it sometimes makes in favorable years, and its high reputation in eastern Europe, make further experiments under other conditions desirable. At Fresno the vine has not borne well, and the must seems to be low in acid. At Pomona the Kadarkas has just come into bearing, but it gives indications of being very well adapted to the conditions which exist there.

ANALYSES OF MUSTS AND WINES.

KADARKAS.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body[1]
						By Weight	By Volume		At Pressing	At Six Months	
1890—No. 1307. Cupertino	Oct. 6	21.30		.72	.27	8.27	10.36	.138	.62	.40	2.58
No. 1418. Mission San José	Oct. 27	25.85		.58	.28	10.35	12.82	.233	.62	.48	3.58
1891—No. 1461. Fresno	Aug. 29	23.70	23.13	.42							
1892—No. 1787. Mission San José	Oct. 18	23.70		.68							
1893—No. 1986. Mission San José	Oct. 17	22.20	21.80	.68	.20	7.92	9.90	.371	.57	.54	3.10
No. 2042. Cupertino	Oct. 30	23.20		.57				.440			
1894—No. 2257. Mission San José	Oct. 5	20.85		.47				.149			

COLOR READINGS.

KADARKAS.	At Pressing.	One Month.	Two Months.	Three Months.	Four Months.	Five Months.
1893—No. 1986. Mission San José		20.0 4VR	20.0 4VR	15.8 5VR	5.7 3R(Y)	4.0 (Y)
No. 2042. Cupertino	45.5 1VR					
1894—No. 2257. Mission San José	15.0 1R					

RECORD OF TREATMENT.

No. 1307. *Kadarkas*, from Cupertino. Received October 8, 1890, in good condition—a few grapes cracked by the rain, but none moldy; not quite mature. The must showed 21.3% of solid contents by spindle and 0.72% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 86°, on the fourth day. On the fifth day the wine was dry and was racked off.

The wine was somewhat slow in clearing, but at one month, though still cloudy, promised well and possessed a very pleasant aroma and agreeable acid. At three months it had been racked twice, and was bright; but the lees showed some filaments, and the taste was slightly suspicious, so the wine was pasteurized. Otherwise, it had a light, pleasing bouquet, good flavor, medium acid and astringency; generally of good quality. At seven months it had improved; it was bright, clean-tasting, of delicate bouquet, full flavor—a light but harmonious wine of good quality. It was racked twice after this, and at fifteen months was in first-class condition, with full bouquet and flavor, little color, very fresh, and mature. Two months later part was bottled, and at two years the remainder was bottled. At twenty-seven months both bottlings were smooth and agreeable, with very light color; the second bottled was brighter and cleaner-tasting.

No. 1418. *Kadarkas*, from Mission San José. Received October 30, 1890, in good condition, and mature. The must showed 25.85% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 87°, on the fourth day. The wine was racked off the sixth day, when it was dry.

At one month the wine was clear, with strong, pleasing aroma and flavor, good acid, and medium astringency; full-bodied, smooth, and well developed. The lees early showed a few filaments, but the taste was unaffected, and at three months the wine was bright and well developed. At six months the wine had been racked twice, and was in very good order. At thirteen months it was bright, retained a fair color, showed marked and characteristic bouquet and flavor—an excellent wine but for a slight bitterness of aftertaste; the wine had kept very well, considering the small quantity (two gallons). At fifteen months it was bottled. One year after bottling the wine was smooth and agreeable, but not quite clean-tasting.

No. 1461. *Kadarkas*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 31, 1891, in good condition. The must showed 23.7% of solid contents by spindle and 0.42% of acid.

No. 1787. *Kadarkas*, from Mission San José. A sample for must analysis arrived October 21, 1892, in poor condition. The must showed 23.7% of solid contents by spindle and 0.68% of acid.

No. 1986. *Kadarkas*, from Mission San José. Received October 19, 1893, in good condition. The bunches were of medium size, regular cylindrical, with one wing about one third the length of the bunch, well filled, but not compact; the berries were of medium size, round, juicy, thin-skinned, well colored, and mature. The must showed 22.2% of solid contents by spindle and 0.68% of acid. The temperature of the grapes at crushing was 61°, and the maximum reached was 81°, on the fourth day. On the fifth day the wine was drawn off, dry.

The wine remained cloudy for some time, but at six weeks, when it was racked for the first time, was clear. At three months it was clear, but not bright, had full acid and astringency and clean taste. After this it improved, was at first somewhat green, but at ten months had developed some bouquet, had good flavor, and was altogether a good wine, though lacking in color.

No. 2042. *Kadarkas*, from Cupertino. A sample for must analysis and for color and tannin tests arrived October 31, 1893, in good condition. The bunches were small, cylindrical, sometimes branched, close; the berries were medium to large in size, rather pulpy, but soft, sweet, and well colored. The must showed 23.2% of solid contents by spindle and 0.57% of acid.

GROSSBLAUE.

(See Vit. Rept. 1883-84, p. 92; 1885-86, p. 75; 1887-89, p. 249.)

Synonyms: Kölner; Blauer Kölner.

Description.—Vine vigorous, with slender, reddish-brown canes; leaves small, five-lobed, split to the middle, red-veined, woolly below and on the petiole, lateral sinuses very obtuse at the base, and often with a large tooth; bunches large, pyramidal, and close; berries large, dark-colored, sweet, and agreeable as an eating-grape. Both the berries and the leaves are smaller in California than they are described as being in Europe. The wine, which in Europe is lacking in color, is here remarkable for both the quality and the intensity of the color. These differences are almost too great to be laid to change of local conditions, and throw some doubt on the identification of the variety.

Later experiments with this variety show that with proper care a good wine can be made from it. The wine always has a beautiful and stable color, good acid and astringency. When the grapes are allowed to attain complete maturity, with 24% to 25% of solid contents, the wine is very smooth and soft, somewhat of Burgundy character, but with more of a Claret color. The chief defects of the grapes are a somewhat neutral character and a tendency to coulure, unless pruned long.

ANALYSES OF MUSTS AND WINES.

GROSSBLAUE.			Date of Picking	MUST.				WINE.					
				Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
								By Weight	By Volume		At Pressing	At Six Months	
1890—	No. 1381.	Mission San José	Oct. 18	25.10	......	.77	.27	10.07	12.54	.263	.62	.34	3.08
1891—	No. 1555.	Paso Robles	Oct. 6	26.60	......	.36	......	......	......	......	......	......	......
	No. 1604.	Mission San José	Oct. 27	24.90	25.19	.54	......	10.26	12.73	.320	.45	.47	3.35
1892—	No. 1682.	Tulare	Sept. 19	24.80	......	.33	......	......	......	......	......	......	......
	No. 1751.	Paso Robles	Oct. 11	22.60	......	.49	......	......	......	......	......	......	......
	No. 1768.	Mission San José	Oct. 13	20.00	19.08	.83	......	8.34	10.42	.262	.77	.53	2.30
1893—	No. 1829.	Amador station	Sept. 7	21.95	......	.95	......	......	......	.451	......	......	......
	No. 1881.	Paso Robles	Sept. 14	21.50	21.22	.76	.30	8.64	10.58	.182	.59	.59	3.20
	No. 1937.	Tulare	Oct. 12	25.00	24.64	.49	.43	......	......	.417	......	......	......
	No. 2129.	Cupertino	Nov. 3	23.70	......	.82	......	......	......	.249	......	......	......
1894—	No. 2253.	Mission San José	Oct. 5	22.20	......	.68	......	......	......	......	.65	......	......
	No. 2285.	Amador station	Oct. 6	25.45	......	.58	......	......	......	......	......	......	......
	No. 2323.	Tulare	Oct. 15	25.00	......	.46	......	......	......	......	......	......	......

COLOR READINGS.

GROSSBLAUE.			At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1891—	No. 1604.	Mission San José	102.6	1VR	95.2	1VR	44.0	2VR	......		......		......	
1892—	No. 1768.	Mission San José	95.2	2VR	83.3	1VR	65.2	1VR	59.7	1VR	60.6	1VR	49.4	1VR
1893—	No. 1829.	Amador station	115.0	VR	115.0	VR	......		......		......		......	
	No. 1881.	Paso Robles	45.5	VR	37.4	1VR	27.5	3VR	23.6	3VR	23.8	3VR	19.4	5VR
	No. 1937.	Tulare	36.0	1VR	......		......		......		......		......	
	No. 2129.	Cupertino	70.2	2VR	......		......		......		......		......	
1894—	No. 2253.	Mission San José	85.1	VR	......		......		......		......		......	

RECORD OF TREATMENT.

No. 1381. *Grossblaue*, from Mission San José. Received October 20, 1890, in bad condition, crushed and moldy. The must showed 25.1% of solid contents by spindle and 0.77% of acid. The temperature of the must at crushing was 68°, and the maximum reached was 89°, on the second day. On the fourth day the murk was dry, and was drawn off.

At one month the wine was nearly clear, with low acid, good astringency and flavor, but a little taste of mold. At six weeks the lees were sound, and the wine was racked. At three months the lees showed a few filaments, and the wine was pasteurized; it was bright, but had not improved much. At seven months it was in good condition, much improved, moldiness nearly gone, full-bodied, but without much character. It remained in good order for some months after this, but at fifteen months, when it was bottled, it had deteriorated, tasted flat, and lacked bouquet.

No. 1555. *Grossblaue*, from Paso Robles station. Received October 8, 1891, in good condition, and mature. The bunches were small and well filled with grapes overaverage in size. No wine was made. The must showed 28.6% of solid contents by spindle and 0.36% of acid.

No. 1604. *Grossblaue*, from Mission San José. Received October 28, 1891, in bad condition. The must showed 24.9% of solid contents by spindle and 0.36% of acid. The temperature of the grapes at crushing was 67°, and the maximum of 86° was reached on the second day. On the third day the murk was nearly dry, and was drawn off.

In one month the wine was clear, but still retained a little sugar. The lees were examined, and proved to be sound. At two months the wine was bright, full-flavored and full-bodied, but a little flat. The lees were examined again at three and at five months, but no bad germs were found. At ten months the wine was racked for the third time. At sixteen months it was in good order, had developed some bouquet, and was generally much improved. Part of it was bottled and the rest racked into a smaller keg. Six months later it had acquired a slight bitterness, but was otherwise a good wine. At twenty-two months the rest was bottled. Two years after bottling the wine was perfectly bright, without deposit—a very smooth, soft wine of Burgundy type, lacking in character, but very agreeable and of beautiful color.

No. 1682. *Grossblaue*, from Tulare station. A sample for must analysis was received September 21, 1892, in good condition. The must showed 24.8% of solid contents by spindle and 0.33% of acid.

No. 1751. *Grossblaue*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 22.6% of solid contents by spindle and 0.49% of acid.

No. 1768. *Grossblaue*, from Mission San José. Received October 15, 1892, in good condition. The must showed 20.0% of solid contents by spindle and 0.83% of acid. The temperature of the must at crushing was 58°, and the maximum reached was 88°, on the fifth day. On the seventh day the murk was drawn off, nearly dry.

A month from pressing the wine was clear, but still had a trace of sugar. It was racked, and two months later was bright, with little bouquet, but good flavor, clean taste, medium acid, astringency, and body. At five months it was in good order and of advanced development. At eight months it had been racked three times, and had developed some bouquet. After this it remained bright, and at fourteen months was a good wine, but lacking somewhat in flavor. At sixteen months it was mature, and was bottled. Eighteen months after bottling the wine was bright, without deposit—a light, somewhat greenish wine, of agreeable flavor and beautiful color.

No. 1829. *Grossblaue*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition. The bunches were small and somewhat coulured; the berries very unequal in size, well colored. The must showed 21.95% of solid contents by spindle and 0.95% of acid.

No. 1881. *Grossblaue*, from Paso Robles station. Received September 16, 1893, in good condition. The bunches were very varied, some small and loose, some large and more compact; the berries were large, well colored, and mature. The must showed 21.5% of solid contents by spindle and 0.76% of acid. The temperature of the must at crushing was 68°, and the maximum reached was 87°, on the third day. On the fifth day the murk was nearly dry, and was drawn off.

At one month the wine was clear, clean-tasting, and with high acid. After the second racking at four months it was bright, well flavored, but somewhat thin and the acid rather green. It improved after this, and developed some bouquet, but the acid continued somewhat raw. At eleven months the lees were examined, and they showed some *S. pastorianus*. At this time the wine was not mature, but of good quality. At eighteen months the wine was bright, improved, nearly mature, of fair bouquet and flavor. It was bottled a month later. Eleven months after bottling the wine was bright, of medium acid and astringency—a very good wine, but without marked character.

No. 1937. *Grossblaue*, from Tulare station. A sample for must analysis was received October 13, 1893, in good condition. The bunches were small, round, loose; the berries of good size, soft, and very sweet. The must showed 25.0% of solid contents by spindle and 0.49% of acid.

No. 2129. *Grossblaue*, from Cupertino. A sample for must analysis arrived November 5, 1893, in good condition. The bunches were of good size, conical, branching, and well filled; the berries of medium size, juicy, commencing to dry. The must showed 23.7% of solid contents by spindle and 0.82% of acid.

BLUE PORTUGUESE.

(See Vit. Rept. 1887–89, p. 242.)

The latest results obtained with the Blue Portuguese confirm the opinions expressed in the last report. It is a good grower, bears well, matures early, and preserves its soundness remarkably well; in the northern coast counties it makes a heavy-bodied wine, with good color and astringency, but low acid and consequent poor keeping qualities. The average composition of the must has been: at Mission San José, sugar 24.72% and acid 0.41%; at Cupertino, sugar 25.92% and acid 0.56%. At Tulare the vine is a good grower, shades its grapes well, and bears heavily, even in somewhat strong alkali soil. The defects of its wine, however, are increased there, and it loses most of the intensity of color that distinguishes it in other localities. The average composition of the musts analyzed at the station has been 22.5% of sugar and 0.40% of acid; but this includes some of imperfectly ripe grapes; the average acid content of ripe grapes is little over 0.30%. The wine is thus difficult to ferment, is flat-tasting, and of poor keeping qualities. It cannot, therefore, be recommended for Tulare County, in spite of its steady and abundant crops, for its lowness in acid is a fatal defect. The grapes may doubtless be advantageously used for blending with grapes of high acid, and tannin, and without detriment to their quality.

ANALYSES OF MUSTS AND WINES.

BLUE PORTUGUESE.		Date of Picking	MUST.				WINE.						
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
							By Weight	By Volume		At Pressing	At Six Months		
1890—No. 1206.	Fresno	Aug. 12	24.25	23.81	.38	.63	16.22	19.96*	.160	.48	.41	3.08*	2.02
No. 1262.	Mission San José	Sept. 24	24.35	......	.45	.33	9.63	12.00	.217	.48	.50	2.58	......
No. 1365.	Cupertino	Oct. 14	26.10	......	.39	......	......	......	......	......	......	......	......
No. 1399.	Cupertino	Oct. 18	27.60	......	.50	......	......	......	......	......	......	......	......
1891—No. 1440.	Tulare	Aug. 24	24.38	......	.30	......	......	......	......	......	......	......	......
No. 1511.	Mission San José	Sept. 24	24.35	......	.39	......	9.92	12.36	.327	.46	.42	3.35	......
1892—No. 1618.	Tulare	Aug. 28	24.35	22.20	.35	.50	9.20	11.45	.127	.32	.50	3.58	......
No. 1683.	Mission San José	Sept. 24	22.15	......	.55	......	8.84	11.00	.252	.48	.50	2.12	......
1893—No. 1813.	Tulare	Aug. 30	19.30	18.89	.57	.44	7.43	9.27	.202	.47	.41	2.95	......
No. 1815.	Tulare	Sept. 2	20.04	20.00	.50	.48	7.78	9.73	.134	.47	.47	3.00	......
No. 1985.	Mission San José	Oct. 17	27.40	27.25	.45	......	11.62	14.20	.400	.51	.47	3.30	......
No. 2038.	Cupertino	Oct. 29	23.50	......	1.05	......	......	......	.451	......	......	......	......
No. 2113.	Cupertino	Nov. 3	24.40	......	.56	......	......	......	.321	......	......	......	......
1894—No. 2137.	Tulare	Sept. 3	24.45	24.22	.29	.42	9.85	11.50	.229	.43	.57	4.35	......
No. 2256.	Mission San José	Oct. 5	23.70	......	.40	......	......	......	......	.38	......	......	......

* Fortified.

COLOR READINGS.

BLUE PORTUGUESE.		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1891—No. 1511.	Mission San José	95.2	1VR	71.4	1VR	55.5	2VR	55.5	2VR	44.9	3VR	37.0	5VR	......	
1892—No. 1618.	Tulare	16.6	R	16.0	1VR+Y	15.6	1VR+Y	14.2	1VR+Y	12.9	1VR+Y	12.9	1VR+Y	12.5	1VR+Y
No. 1683.	Mission San José	142.0	VR	54.1	1VR	43.5	1VR	42.1	1VR	41.6	1VR	40.0	1VR	......	
1893—No. 1813.	Tulare	21.1	3VR	9.3	2R	9.2	3R	9.5	3R	8.3	(Y)	8.3	(Y)	......	
No. 1815.	Tulare	18.8	4VR	11.2	5VR	7.6	4R	8.5	4R	......		......		......	
No. 1985.	Mission San José	100.0	VR	62.5	1VR	57.1	1VR	57.1	1-2VR	42.5	2VR	32.0	3VR	......	

RECORD OF TREATMENT.

No. 1206. *Blue Portuguese*, from Fresno. Received August 14, 1890, in fair condition, and quite mature. The must showed 24.25% of solid contents by spindle and 0.38% of acid. The temperature of the must at crushing was 69°, and the maximum reached was 77°, on the fourth day. On the fifth day the fermentation was very slow, and the must showed 7.5% of solid contents by spindle; it was drawn off and fortified.

At four months the wine was bright, but harsh, unpleasing, and somewhat bitter. At this date it was racked and put into the hot-box, where it was kept at a temperature of 110° for three months. At two months after heating it was bright, dark-colored, of good bouquet, much improved in flavor, but still a little bitter. It was racked again, and at seventeen months after crushing was in good order, a fairly agreeable wine, but too acid and with very little Port character. At two years and a half it was smooth and clean-tasting, with some flavor, but too much acid. Four months later it had deteriorated.

No. 1262. *Blue Portuguese*, from Mission San José. Received September 26, 1890, in fair condition, and mature. The must showed 24.35% of solid contents by spindle and 0.45% of acid. The temperature of the must was 67° at starting, and 87° was the maximum, reached on the fourth day. On the fifth day the murk was nearly dry, and was drawn off.

The wine was slow in clearing and soon developed filaments in the lees. At two months it was clear, of low acid and good astringency, dark-colored, coarse and rough. At three months the wine was pasteurized; it was clear, but the taste was suspicious, and the lees showed a good many filiform germs. At seven months it was bright, with very little taste, due to improper fermentation; it had improved generally, and was a smooth, agreeable wine, but a little flat. After this it remained clear, but deteriorated in quality, and became tasteless and flat. It was racked twice, and at sixteen months put in bottle. Two years after bottling it was tasted and found to have changed very little; it had kept its color well, but was insipid.

No. 1365. *Blue Portuguese*, from Cupertino. A sample for must analysis was received October 17, 1890, in fair condition, a little dried and past maturity. The must showed 26.1% of solid contents by spindle and 0.39% of acid.

No. 1399. *Blue Portuguese*, from Cupertino. A sample for must analysis arrived October 21, 1890, in poor condition—shriveled, moldy, and overripe. The must showed 27.0% of solid contents by spindle and 0.50% of acid.

No. 1440. *Blue Portuguese*, from Tulare station. A sample for must analysis arrived August 27, 1891, in good condition. The must showed 24.38% of solid contents by spindle and 0.30% of acid.

No. 1511. *Blue Portuguese*, from Mission San José. Received September 27, 1891, in rather moldy and crushed condition. The must showed 24.35% of solid contents by spindle and 0.39% of acid. The temperature of the grapes at crushing was 67°, and the maximum of 91° was reached on the third day. The wine was nearly dry on the fourth day, when it was drawn off.

In one month the wine was quite clear and dry, very rough, and smelled a little moldy. A little later the lees showed a few filaments, and in a month the taste was beginning to be affected, so the wine was pasteurized. Four months after pasteurizing it had improved, was bright, very heavy-bodied, still coarse and flat. After this the wine was racked twice, and improved a little; at sixteen months it was a fair wine, and the unsound fermentation was quite arrested; it tasted a little flat, however. A few days later it was put in bottle.

No. 1618. *Blue Portuguese*, from Tulare station. Received September 1, 1892, in good condition. The must showed 24.35% of solid contents by spindle and 0.35% of acid. The temperature of the grapes at crushing was 68°, and the maximum, reached on the third day, was 93°. The wine was dry on the fifth day, when it was drawn off.

The wine was slow in clearing, and fermented for some time after pressing. At six weeks it was dry, and was pasteurized, as it tasted a little suspicious. At four months it was clear, but very inferior. At six months it was bright and improved, and would have been a fair wine but for a slight bitterness. From six to eleven months it was at its best, and changed very little. After that it deteriorated. At sixteen months it was bottled.

No. 1683. *Blue Portuguese*, from Mission San José. Received September 27, 1892, in good condition. The must showed 22.15% of solid contents by spindle and 0.55% of acid. The temperature of the grapes at crushing was 67°, and the maximum, reached on the third day, was 93°. The wine was dry on the fourth day, when it was racked off.

At three weeks, when it was racked and taken to the cellar, it was clear, but not very clean-tasting. At three months it was bright, with full bouquet and flavor, medium acid, good astringency—an agreeable wine, but lacking in after-taste. After this it remained in good order, and improved but never became quite clean-tasting. At eleven months it showed good quality, but had a disagreeable odor. It soon matured, and at eighteen months was bottled.

No. 1813. *Blue Portuguese*, from Tulare station. Received September 1, 1893, in fair condition, a little moldy. The bunches were of good size and without coulure; the berries of good size, thin-skinned, and with little flavor. The must showed 19.3% of solid contents by spindle and 0.57% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached, on the sixth day, was 91°. On the seventh day the wine was drawn off, dry.

At one month the wine was clear, and at four months bright, but of poor quality. At ten months it had been racked twice, was clear, but flat, and with a disagreeable odor. It was little better than No. 1815.

No. 1815. *Blue Portuguese*, from Tulare station. Received September 4, 1893, in good condition. The must showed 20.04% of solid contents by spindle and 0.60% of acid. The temperature of the must at crushing was 67°, and the maximum, reached on the third day, was 100°. On the fourth day the wine was dry, and was racked off.

The wine was slow in clearing, and at one month was still cloudy and not clean-tasting. It was racked and taken to the cellar, and at five months, when it was racked for the second time, it was clear, but flat and of poor quality. After this, though it remained clear, it did not improve in quality, and at eleven months it was bright, but flat and poor.

No. 1985. *Blue Portuguese*, from Mission San José. Received October 19, 1893, in good condition, and very ripe. The bunches were rather large to medium, well filled, conico-cylindrical, with large shoulders, on very thick, woody peduncles; the berries were small, nearly round, thin-skinned, fleshy, and soft, very ripe, but very few dried. The must showed 27.4% of solid contents by spindle and 0.45% of acid. The temperature of the must at crushing was 59°, and the maximum, reached on the fifth day, was 85°. On the seventh day the wine was drawn off, though not quite dry.

At six weeks the wine was clear, but bitter. At three months it was bright, of good body, high astringency, medium acid, little bouquet, and some flavor; still a little bitter. At six months it had changed little, but had become a little flat. At nine months it showed some good qualities, but was not quite clean-tasting.

No. 2038. *Blue Portuguese*, from Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The bunches were over-medium in size, long conical, shouldered, close; the berries of medium size, round, much shriveled, and overripe. The must showed 23.5% of solid contents by spindle and 1.05% of acid.

No. 2113. *Blue Portuguese*, from Cupertino. A sample for must analysis arrived November 5, 1893, in good condition. The bunches were of medium size, long conico-cylindrical, close; the berries pulpy, very sweet, overripe, and commencing to shrivel, but without any raisin taste. The must showed 24.4% of solid contents by spindle and 0.56% of acid.

ZINFANDEL.

(See Vit. Rept. 1883-85, p. 98; 1885-86, p. 80; 1887-89, p. 230.)

Description.—Vine a vigorous grower, with grayish-brown wood; leaf dark green, lobed, with lighter green below, rather hairy or woolly, long; leaf-stem reddish, also long and wavy, young shoots slightly tomentose, tinged with red; bunches long and heavy, shouldered, often double or the shoulder as long as the main bunch, stem short and strong, brown, compact; berry medium, round, black with blue bloom and a peculiar star-like dot in the center, but often intermingled with small shriveled berries, ripening unevenly, very juicy, with a lively acid mingling with the sweet; skin thin. The vine is very productive, easy of cultivation, often producing a second and even a third crop from the laterals. Well adapted to short stool-pruning, and 3 to 4 feet stakes. (Prof. George Husmann.)

ANALYSES OF MUSTS AND WINES.

ZINFANDEL.	Date of Picking	MUST.				WINE.							
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Ash	Sugar
						By Weight	By Volume		At Pressing	At 6 to 8 Months			
1890—No. 1253. Fresno	Aug. 25	23.70	24.11	.54	.42	9.34	11.64	.199	.58	.45	2.78	.31	.22
No. 1253*a*. Fresno	------	------	------	------	------	9.20	11.45	.191	.59	.52	3.32	.55	.24
No. 1253*b*. Fresno	------	------	------	------	------	9.27	11.55	.199	.46	.48	3.08	.48	.22
No. 1257. Amador station	Sept. 23	22.60	------	.55	.29	10.35	12.82	.241	.54	.50	2.82	------	------
1892—No. 1656. Amador station	Sept. 16	23.73	------	.69	------	------	------	------	------	------	------	------	------

COLOR READINGS.

ZINFANDEL.	At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.	
1890—No. 1253. Fresno	26.5	3VR	3.6	1VR+2Y	4.0	2VR+2Y	4.4	2VR+2Y	Too light for instrument.			
No. 1253*a*. Fresno	33.7	3VR	8.6	R	9.6	R	9.7	R	3.6	2VR+2Y	------	
No. 1253*b*. Fresno	26.2	2VR	11.0	4VR	10.8	R	7.8	2R	3.6	2R+1Y	------	
No. 1257. Amador station	37.0	4VR	14.7	5VR	12.7	5VR	10.0	R	10.0	R-1R	3.8	3VR+1Y
1892—No. 1656. Amador station	Too light for instrument.											

RECORD OF TREATMENT.

No. 1257. *Zinfandel*, from Amador station. Received September 26, 1890, in poor condition; the grapes were badly crushed and some of them moldy. The bunches were of average size, compact, and shouldered; the berries small to medium, quite mature. The must showed 22.6% of solid contents by spindle and 0.55% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached, on the fourth day, was 77°. The fermentation was very slow, and the wine was still very sweet when it was drawn off on the sixth day.

At two weeks the wine was still very sweet and fermenting. At one month it was turbid, fermenting, and contained about 0.4% of sugar. At two months it was clear and dry, of fair color, low acid, high astringency, and strong, characteristic flavor. Two weeks later the lees showed some filaments under the microscope, and the wine was pasteurized at 160° F. At three months the lees appeared sound, and at seven months the wine was bright and had improved very much in smoothness. At eight months it was racked for the third time. At fourteen months it was in good order, full-flavored, nearly mature, and had developed some bouquet. At seventeen months it was racked and part put in bottle; six months later the rest was bottled. At three years and three months both samples were in first-class condition, with little bouquet, strong Zinfandel flavor, and clean taste. That bottled at seventeen months was more highly flavored and of deeper color, while that bottled at twenty-three months was smoother.

No. 1656. *Zinfandel*, from Amador station. A sample for must analysis was received September 19, 1892, in poor condition. The must showed 23.7% of solid contents by spindle and 0.69% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF AUSTRIAN AND HUNGARIAN TYPE—RED.

Number.	LOCALITY.	Vintage of.	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Kadarkas.										
1307	Cupertino	1890	21.30		.72	.27	10.36	.138	.62	.40	2.58
2042	Cupertino	1893	23.20		.57			.440			
1418	Mission San José	1890	25.85		.58	.28	12.82	.233	.62	.48	3.58
1787	Mission San José	1892	23.70		.68						
1986	Mission San José	1893	22.20	21.80	.68	.20	9.90	.371	.57	.54	3.10
2257	Mission San José	1894	20.85		.47			.149			
1461	Fresno	1891	23.70	23.13	.42						
	Average, Cupertino		**22.25**		**.64**	**.27**	**10.36**	**.289**	**.62**	**.40**	**2.58**
	Average, Mission San Jose		**23.15**	**21.80**	**.60**	**.24**	**11.36**	**.376**	**.59**	**.51**	**3.34**
	Grossblaue.										
1381	Mission San José	1890	25.10		.77	.27	12.54	.263	.62	.34	3.08
1604	Mission San José	1891	24.90	25.19	.54		12.73	.320	.45	.47	3.35
1768	Mission San José	1892	20.00	19.08	.83		10.42	.262	.77	.53	2.30
2253	Mission San José	1894	22.20		.68				.65		
1555	Paso Robles	1891	26.60		.36						
1751	Paso Robles	1892	22.60		.49						
1881	Paso Robles	1893	21.50	21.22	.76	.30	10.58	.182	.59	.59	3 20
1682	Tulare	1892	24.80		.33						
1937	Tulare	1893	25.00	24.64	.49	.43		.417			
2823	Tulare	1894	25.00		.46						
1829	Amador station	1893	21.95		.95			.451			
2285	Amador station	1894	25.45		.58						
2129	Cupertino	1893	23.70		.82			.249			
	Average, Mission San Jose		**23.10**	**23.13**	**.70**	**.27**	**11.89**	**.281**	**.62**	**.44**	**2.91**
	Average, Paso Robles		**23.56**	**21.22**	**.53**	**.30**	**10.58**	**.182**	**.59**	**.59**	**3.20**
	Average, Tulare		**24.93**	**24.64**	**.42**	**.43**		**.417**			
	Average, Amador station		**24.48**		**.70**			**.249**			

	Blue Portuguese.										
1200	Fresno	1890	24.25	23.81	.38	.63	*19.96	.160	.48	.41	*3.08
1262	Mission San José	1890	24.35		.45	.33	12.00	.217	.48	.50	2.58
1511	Mission San José	1891	24.35		.39		12.36	.327	.46	.42	3.35
1683	Mission San José	1892	22.15		.55		11.00	.252	.48	.50	2.12
1985	Mission San José	1893	27.40	27.25	.45		14.20	.400	.51	.47	3.80
2256	Mission San José	1894	23.70		.40				.38		
1365	Cupertino	1890	26.10		.39						
1899	Cupertino	1890	27.60		.50						
2038	Cupertino	1893	23.50		1.05			.451			
2113	Cupertino	1893	24.40		.56			.321			
1440	Tulare	1891	24.38		.30						
1618	Tulare	1892	24.35	22.20	.35	.50	11.45	.127	.32	.50	3.58
1813	Tulare	1893	19.30	18.89	.57	.44	9.27	.202	.47	.41	2.95
1815	Tulare	1893	20.04	20.00	.50	.48	9.73	.134	.47	.47	3.00
2137	Tulare	1894	24.45	24.22	.29	.42	11.50	.229	.43	.57	4.35
	Average, Mission San Jose		**24.39**	**27.25**	**.44**	**.33**	**12.39**	**.299**	**.46**	**.47**	**2.83**
	Average, Cupertino		**25.40**					**.386**			
	Average, Tulare.		**22.50**	**21.32**	**.40**	**.46**	**10.48**	**.173**	**.42**	**.48**	**3.47**
	Zinfandel.										
1253	Fresno	1890	23.70	24.11	.54	.42	11.64	.199	.58	.45	2.78
1257	Amador station	1890	22.60		.55	.29	12.82	.241	.54	.50	2.82
1656	Amador station	1892	23.73		.69						
	Average, Amador station		**22.15**		**.62**	**.29**	**12.82**	**.241**	**.54**	**.50**	**2.82**

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* Fortified.

B. WHITE-WINE GRAPES.

WHITE RHENISH TYPE.

The Rhenish grapes were among the first to be tried in California, and they have been tested, perhaps, more widely than any others. Very little wine, however, has been made in California that at all resembles the true Rhine wines. Many of our Riesling wines bear a much closer resemblance to Sauternes than to Rhine wines. This is to some extent due, as is generally understood by wine-growers, to the high percentage of sugar which the German grapes attain here at maturity. The problem, as generally understood, is to produce grapes which possess a moderate amount of sugar when perfectly ripe. The method of dilution with water before fermentation is, without doubt, incompatible with the production of the finest wines, but is probably less harmful to quality than is generally supposed, and if applied intelligently, and with a full knowledge and understanding of the conditions, will certainly result in much better wines than many California Rieslings.

Our failure to produce wines of the true Rhine-wine type is probably due more to the conditions of fermentation and treatment than to difference in must composition. Though most of the common German wines are very acid and of low alcoholic strength, the high-class wines are, in many cases, nearly or quite as high as our California Rieslings in alcohol, and no higher in acid. The slow, cool fermentation which the wines of Johannisberg and Steinberg undergo has doubtless much to do with their superior qualities. Our efforts, then, in California to produce similar wines should be directed toward temperature control and the elimination of injurious ferments.

JOHANNISBERG RIESLING.

(See Vit. Rept. 1885–86, p. 99.)

Synonyms: Weisser Riesling; Gentil aromatique.

Description.—Vine somewhat slender, with semi-erect canes; leaves of average size, thick, three or five lobed, petiolar sinus closed, upper surface dark green, glabrous and rugose, lower surface pale green and tomentose; bunch conico-cylindrical and compact; berries small, variable in size, spherical, punctate, sweet, and aromatic. The variety is easily distinguished from its less noble namesake, the Franken Riesling or Sylvaner, by its lobed and slightly pubescent, furzy leaves; it is also usually a slower grower and lighter bearer.

Of all the German varieties thus far tested in California, this is the one which has retained most of the qualities for which it is famous in its original district. This is true only of certain localities in California, where some good wines have been obtained from this variety, not, however, so delicate as the product of the Rhine district. It is a vigorous and fairly healthy vine, though it does not always set well at flowering, and is subject to *oidium;* it is, however, a rather poor bearer. It gives best results on a granitic or schist formation, and will not thrive on undrained soils. It ripens during the second period. It requires long-pruning, and the green canes should be tied up, as they are very brittle and easily broken by the wind. With long-pruning the crop has been about two and a half tons per acre at Cupertino, and with short-pruning almost nothing.

The best results are obtained with this variety in the coolest localities, in parts of the Santa Cruz Mountains for example. The average must composition at Cupertino has been 22.5% of sugar and 0.53% of acid, and about the same at Mission San José. This is somewhat lower in sugar and higher in acid than the other German varieties have shown. The Johannisberger is the most aromatic of the German grapes, with the exception of the Traminer, and is the best suited to producing a satisfactory wine without blending; it ferments well and is a good keeper.

TABLE OF PRODUCTION.

JOHANNISBERG RIESLING.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 741 (short-pruned). J. T. Doyle, Cupertino	20	10	0.5	Oct. 14
No. 742 (long-pruned). J. T. Doyle, Cupertino	20	123	6.1	Oct. 14
1888—No. 874 (short-pruned). J. T. Doyle, Cupertino	19	35	1.8	Oct. 1
No. 875 (long-pruned). J. T. Doyle, Cupertino	14	75	5.3	Oct. 1
1889—No. 1139. J. T. Doyle, Cupertino	20	210	10.5	Oct. 2

ANALYSES OF MUSTS AND WINES.

JOHANNISBERG RIESLING.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at 6 to 8 Months	Volatile Acid	Body	Ash
1885—No. 461.* Gundlach & Co., by Dr. E. J. Fraser, San Francisco						9.92	12.36	.56		2.10	.21
1886—No. 487. J. T. Doyle, Cupertino	Sept. 23	20.40	18 48	.65	.27	7.78†	9.73	.60		1.80	
No. 632.* J. Schramm, St. Helena						9.41	11.73	.56		2.10	.15
No. 652.* Captain Niebaum, Napa						9.56	11.91	.61		1.30	.37
No. 663.* H. W. Crabb, Oakville						10.07	12.50	.38		2.60	.23
No. 538. D. C. Feely, Patchen	Oct. 17	19.30	18.29	.36	.26	7.09†	8.85	.55		1.80	
1887—No. 742 (long-pruned) J. T. Doyle, Cupertino	Oct. 14	21.24	20.24	.43	.40	8.84	11.00	.54	.09	2.30	
No. 741 (short-pruned). J. T. Doyle, Cupertino	Oct. 14	23.49		.50	.36	Blen	ded	with	No.	761.	
1888—No. 862. J. Gallegos, Mission San José	Sept. 22	23.96	23.61	.46	.33						
No. 874. J. T. Doyle, Expt. Plot, Cupertino	Oct. 1	22.05	23.13	.35	.31	8.98	11.18	.47		2.10	
No. 875. J. T. Doyle, Expt. Plot, Cupertino	Oct. 1	22.40	22.67	.41	.29						
1889—No. 1068. John Gallegos, Mission San José	Sept. 9	21.95	21.38	.43	.31	8.48	10.58	.55		2.07	
No. 1139. J. T. Doyle, Expt. Plot, Cupertino	Oct. 2	23.60	23.62	.60	.36	9.56	11.91	.52		1.57	
1890—No. 1264. J. T. Doyle, Expt. Plot, Cupertino	Sept. 28	22.15		.66	.26	9.78	12.18	.42		2.40	
1891—No. 1490. Paso Robles station	Sept. 9	24.55		.36							
1892—No. 1777. Mission San José	Oct. 13	22.60		.62							
1893—No. 1994. Mission San José	Oct. 18	22.20		.60							
No. 2033. J. T. Doyle, Cupertino	Oct. 30	23.70		.65							

* Wines sent for examination.

† Analyses made in May, 1887.

RECORD OF TREATMENT.

No. 741. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. Received October 18, 1887, in good condition, and very ripe. The grapes were from short-pruned vines, and were very sweet and showed less coulure than those from long-pruned vines. The must showed 23.49% of solid contents by spindle and 0.50% of acid. The grapes were fermented with No. 742.

No. 742. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. Received October 18, 1887, in good condition, but somewhat unevenly ripened. The bunches showed somewhat more coulure than those from the short-pruned vines, but it was not very bad in either case. The must showed 21.24% of solid contents by spindle and 0.43% of acid. The temperature of the grapes at crushing was 70°, and the maximum, reached on the third day, was 85°. On the seventh day the wine was dry, and on the sixteenth day it was drawn off the thick lees.

At two months the wine was bright and with good aroma, full body, low acid, and well-developed vinosity. A month later it was racked again, and at eight months it was in good condition, with strong aroma and full flavor, pleasant acid, and, in general, of high quality.

No. 862. *Johannisberg Riesling*, from J. Gallegos, Mission San José. A sample for must analysis was received September 25, 1888, in fair condition. The must showed 23.96% of solid contents by spindle and 0.46% of acid.

No. 874. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. Received October 2, 1888, in fair condition; the grapes were crushed, and in some boxes fermentation had already commenced. The bunches were rather looser than normal and the berries were very uneven in size. The must showed 22.05% of solid contents by spindle and 0.35% of acid.

No. 875. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. This sample was from short-pruned vines and differed little from those from long-pruned vines. The must showed 22.41% of solid contents by spindle and 0.40% of acid.

Nos. 874 and 875. The grapes were crushed the day they arrived, but were not pressed until the following morning. The temperature of the grapes at crushing was 74°, and the maximum reached, on the third day, was 79.5°. The wine was dry on the ninth day.

At one month the wine was racked and taken to the cellar. At three months it was clear, with good aroma, and well advanced. Two months later it was pasteurized, and at eight months, when it was racked for the third time, was in good condition and exhibited an extremely marked aroma and pleasing taste. At eleven months it was bright, clean-tasting, and of very high quality. At fourteen months it was nearly or quite mature, and showed a remarkable bouquet. Some wine put in glass at the last racking was bright, clean-tasting, and agreeable, but less pleasing and well developed than the wine in keg. At seventeen months it was racked again, and at eighteen was bottled. At twenty-nine months the wine bottled at nine months had deposited a heavy sediment; it was possessed of high aroma, but the flavor was not good. That bottled at eighteen months was bright and had made no deposit; it had less of the natural grape aroma, but was mature and good. At four years that first bottled had developed into a fine wine, with rich bouquet and agreeable acid. The wine bottled earlier had improved, and was bright, but inferior to the other.

No. 1068. *Johannisberg Riesling*, from J. Gallegos, Mission San José. Received September 12, 1889, in fair condition; the grapes were mature, but some of them were a little moldy. The must showed 21.95% of solid contents by spindle and 0.43% of acid. The temperature of the grapes at crushing was 72°, and the maximum, reached on the third day, was 79°. The wine was dry on the sixth day, when it was drawn off the thick lees.

At one month the wine was almost clear, and showed very good flavor and aroma. A month later it was quite clear and was racked and taken to the cellar. At three months the wine was bright, with marked and pleasing aroma, full, characteristic flavor, but with rather a suspicious after-taste. The wine improved for the next six or eight months, but after that became slightly pricked, and deteriorated.

No. 1139. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. Received October 4, 1889, in good condition, and quite mature. The bunches were small; the berries small and unequal. The must showed 23.6% of solid contents by spindle and 0.60% of acid. The temperature of the grapes at crushing was 71°, and the maximum, reached on the third day, was 79°.

At two months the wine was clear, of very light color, strong and characteristic aroma, pleasing and marked flavor, clean taste, and in general very good. At this time it was racked and taken to the cellar. At four months it had improved and was quite sound. At seven months it retained its good quality, and was racked for the third time. A month later it was quite clear, but had a slightly suspicious taste, so it was pasteurized. Tastings at one and two months after pasteurizing showed that the wine remained sound; but the wine which was put in a demijohn became the brighter and developed a higher quality. A year later the wine was still bright and good, but after that it deteriorated.

No. 1264. *Johannisberg Riesling*, from J. T. Doyle, Cupertino. Received October 2, 1890, in fair condition and ripe, but not very sweet. The must showed 22.15% of solid contents by spindle. The fermentation lasted about eight days, reaching a maximum temperature of 81° on the fourth day.

At three weeks the wine was nearly clear; at seven weeks the lees showed a few filaments. At two months the wine was clear, with good flavor and aroma and full acid. At three months it was nearly bright, and had been racked twice; it had a high, agreeable bouquet and delicate flavor, clean taste and full acid. The lees showed a few lactic germs, but the taste was unaffected; it was pasteurized for safety. At seven months it was bright, of high quality and maturing well. At fourteen months it was clear, had full bouquet and flavor, but was slightly flat and not quite mature. At seventeen months it was racked for the fifth time and part of it bottled; the rest was bottled at twenty-five months. At twenty-seven months both wines were bright and of fair quality; that first bottled was not quite clean-tasting, while the second was a little exhausted.

No. 1490. *Johannisberger*, from Paso Robles station. A sample for must analysis arrived September 11, 1891, in good condition. The must showed 24.55% of solid contents by spindle.

No. 1777. *Johannisberger*, from Mission San José. A sample for must analysis was received October 15, 1892, in good condition. The must showed 22.6% of solid contents by spindle.

No 1994. *Johannisberger*, from Mission San José. A sample for must analysis was received October 19, 1893, in good condition. The bunches were small; the berries of medium size, highly flavored, and very ripe. The must showed 22.2% of solid contents by spindle.

No. 2033. *Johannisberger*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, more or less compact; the berries of medium size, juicy, thin-skinned, with full acid and not quite mature. The must showed 23.7% of solid contents by spindle.

RED TRAMINER.

Synonyms: Savagnin Rose; Gentil Rose; Gewürz Traminer; Roth Edel.

Description.—Vine rather vigorous, with slender, spreading, short-jointed canes; leaves small, wider than long, three-lobed or without sinuses, nearly glabrous above and cobwebby below; bunches small, conical, close; berries small, nearly round, pink, juicy, sweet, and very aromatic.

The Traminer is one of the most widely ranging varieties of Europe, as the dozens of synonyms with which it is afflicted sufficiently attest. Under the name of Savagnin the white-fruited variation is common in eastern France, while the rose-fruited variation described above is common in many parts of Germany and Austria. The vine is not very productive, but gives a wine of very marked character, and the grapes are generally fermented with the Franken Riesling or other neutral grape. On account of its thick skin, which protects it from decay, it is often used for the manufacture of "vins de paille."

Where tested in California it has shown itself a shy bearer and requires long-pruning. It retains the high flavor which distinguishes it in Europe, and well maintains its character as the most aromatic of the German grapes. When mature, the grapes have, as in Europe, low acid, viz., 0.3% to 0.5%, but are much higher in sugar than is reported from there, viz., 24.0% to 28.0%. The wine is somewhat difficult to ferment and keep when used alone, but on account of its high aroma and high sugar content it makes an excellent blend with grapes of less flavor and more acid. At the Amador and Tulare stations it is a very shy bearer, and the grapes lose there most of their characteristic flavor. The grapes ripen a little later than the Ruländer and about the same time as the Johannisberger.

ANALYSES OF MUSTS AND WINES.

RED TRAMINER.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body
1889—No. 1075. J. T. Doyle, Cupertino	Sept. 14	26.40	26.31	.41	.41	11.39	13.91	.50	2.65
1890—No. 1211. Margherita Vineyard, Fresno	Aug. 21	25.90	25.76	.52	.39	......	......	......	......
No. 1304. J. Gallegos, Mission San José	Oct. 5	25.10	......	.38	.39	10.35	12.82	.42	2.15
1891—No. 1542. Paso Robles	Oct. 4	23.70	......	.36	......	......	......	......	......
1893—No. 1810. Amador	Aug. 29	23.50	......	.50	......	......	......	......	......
No. 2017. Mission San José	Oct. 25	25.65	24.53	.38	.26	11.23	13.73	.38	3.10
No. 2099. J. T. Doyle, Cupertino	Nov. 5	28.30	......	.31	......	......	......	......	......

RECORD OF TREATMENT.

No. 1075. *Red Traminer*, from J. T. Doyle, Cupertino. Received September 17, 1889, in fair condition, but somewhat crushed. The bunches were very unequal in shape, sometimes simply cylindrical and sometimes very much winged; the berries were small and slightly oval, with thick but tender skin, varying in color from greenish-yellow to pink. The fermentation was normal and complete.

At one month the wine was still a little cloudy, but was quite dry and of agreeable flavor. A week later it was nearly clear, showed good aroma, clean taste, and good flavor. At six weeks it was racked and taken to the cellar. At four months it was clear, of golden color, with very pronounced and characteristic aroma, full flavor, clean taste, and low acid. It was a wine of high quality, with full alcohol and body. Two months later it was racked again, and at eight months the lees were examined and found to contain a few acetic ferments. The taste was unaffected, however, and at nine months the wine was bright, clean-tasting, and well developed; it was a wine of very marked character and good development. At twelve months it was bright, well matured, and tasted perfectly sound, and very aromatic and full flavored. At this date it was racked for the third time. At eighteen months it was bright, but had suffered from being in such a small keg. It had lost somewhat in aroma, but was still of high quality and rich flavor. Wine bottled at twelve months was bright, sound, and equal to that in the keg, but had deposited some sediment. The wine was all bottled at eighteen months. A year later both bottlings showed many of the qualities of a fine wine, but also the effect of having been made in too small quantity.

No. 1211. *Red Traminer*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 23, 1890, in poor condition, overripe. The must showed 25.9% of solid contents by spindle.

No. 1304. *Red Traminer*, from J. T. Doyle, Cupertino. Received October 8, 1890, in very good condition, all well colored and mature. The must showed 25.1% of solid contents by spindle. The fermentation lasted nine days, and was cool, reaching a maximum temperature of 76° on the third day.

At one month from crushing the wine was nearly clear, smooth, and with high aroma, but very raw. At three months the wine had been racked twice, but was not quite clear. The lees showed some lactic taint, which was also perceptible to the taste; the wine was therefore pasteurized. The wine was a long time clearing after being pasteurized, but it remained sound, and the lactic taint gradually disappeared. At the end of fifteen months it was clear and much improved, though somewhat flat. At seventeen months it was racked for the fifth time, and part of it put in bottle; the remainder was bottled at twenty-three months. At two years it was tasted, and neither sample found quite clear or clean-tasting; that first bottled had an extremely high and characteristic aroma, which was much less noticeable in that bottled later.

No. 1542. *Red Traminer*, from Paso Robles station. Received October 6, 1891, in good condition, mature, and highly flavored. The must showed 23.7% of solid contents by spindle. A sample for must analysis only was received.

No. 1810. *Red Traminer*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition; the bunches were small, well filled, and without much of the characteristic flavor. The must showed 23.5% of solid contents by spindle.

No. 2017. *Red Traminer*, from Mission San José. Received October 26, 1893, in fair condition. The bunches were very small and well filled; the berries small, juicy, highly flavored, and very ripe. The must showed 25.65% of solid contents by spindle. The fermentation was very slow and cool, and the wine never became perfectly dry. This sample was fermented with 36% of Ruländer. (See No. 2018.)

At five weeks from crushing the wine was not clear and was very sweet. At three months it was bright and sound, but still slightly sweet, and possessed of a very high aroma. At four months it was racked for the third time. At seven months it was bright, a little sweet, and had acquired a slight bitter taste.

No. 2099. *Red Traminer*, from J. T. Doyle. Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, compact, with many abortive berries; the berries small to over-medium, thin-skinned, and very juicy, sweet, and mature. The must showed 28.3% of solid contents by spindle.

RULÄNDER.

Synonyms: Pinot gris; Auvernat gris.

Description.—Vine of moderate size and vigor; leaves of medium size, round, three-lobed, distinguished from those of the Pinot noir by their yellowish color; bunches small, close, cylindrical; berries round, juicy, of a light, dull gray-purple.

This variety is considered by most authors as a simple color variation of the ordinary Pinot noir, but the grapes are more highly flavored, and the vine more productive. It bears somewhat better than the Traminer and attains an equally high percentage of sugar. It is considered in Germany as one of the best grapes for the production of sparkling wines, and is valued there for the high percentage of sugar which it attains.

In California its sugar content ranges from 23% to 29%. A sample from Cupertino, allowed to remain too long on the vines, attained 31% of sugar with 0.48% of acid. In general, it shows more acid than the Traminer, varying from 0.4% to 0.6%. At the Amador station it has borne well, and the must averaged 25.5% of sugar and 0.53% of acid. Its flavor is marked and characteristic, though less so than that of the Traminer. It ripens a week or ten days earlier than the latter, and is equally difficult to ferment alone, requiring the addition of some lighter must, such as Franken Riesling.

ANALYSES OF MUSTS AND WINES.

RULÄNDER (OF EUROPE).	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body
1890—No. 1217. Margherita Vineyard, Fresno	Aug. 23	25.20	24.64	.41	.31	-----	-----	-----	-----
No. 1274. J. T. Doyle, Cupertino	Oct. 1	23.36	-----	.55	.29	10.16	12.64	.36	2.28
No. 1315. J. Gallegos, Mission San José	Oct. 9	26.50	-----	.45	.24	12 23	15.00	.36	2.44
1893—No. 1802. Amador	Aug. 29	25.00	-----	.56	-----	-----	-----	-----	-----
No. 2018. J. Gallegos, Mission San José	Oct. 25	28.60	28.02	.50	.20	-----	-----	-----	-----
No. 2098. J. T. Doyle, Cupertino	Nov. 5	31.10	-----	.48	-----	-----	-----	-----	-----
1894—No. 2231. Mission San José	Oct. 2	25.35	-----	.55	-----	-----	-----	-----	-----
No. 2281. Amador	Oct. 4	24.35	-----	.50	-----	-----	-----	-----	-----

RECORD OF TREATMENT.

No. 1217. *Ruländer*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 25, 1890, in fair condition; overripe and somewhat crushed. The must showed 25.2% of solid contents by spindle.

No. 1274. *Ruländer*, from J. T. Doyle, Cupertino. Received October 2, 1890, in fair condition, somewhat bruised and with a few moldy berries; the bunches and berries were both small. The must showed 23.36% of solid contents by spindle. The fermentation was cool, and lasted over a week; the maximum temperature reached was 79°, on the fourth day.

The wine was nearly clear in three weeks, and quite clear in six. At two months it was a rich, generous wine, of marked flavor and aroma, medium acid, and good body and alcohol. After the third racking at six months it was bright, good, and sound, but had lost much of its striking aroma. At fourteen months it had lost still more of its distinctive character, but was still bright and sound. Some of the wine was bottled at fifteen and some at twenty-one months. At twenty-six months both wines were tasted, but neither of them had kept well; the second bottled was the best.

No. 1315. *Ruländer*, from Mission San José. Received October 10, 1890, in very bad condition—moldy and bruised. The must showed 26.5% of solid contents by spindle. The fermentation lasted a week, and attained its maximum temperature of 79° on the fourth day.

At one month the wine was clear, and showed a full and agreeable flavor, some aroma, low acid, and full body. At three months it was pasteurized, the lees showing lactic rods and the taste becoming affected. At seven months the slight lactic taste had disappeared, but the wine was a little flat. At fourteen months the wine was clear, with good bouquet and flavor, but with a slight bitter taste. At sixteen months the wine was bottled, having been racked five times. At twenty-seven months the bottled wine was not quite clear or clean-tasting, but had a full, rich flavor.

No. 1802. *Ruländer*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition; the bunches were small, but well filled. The must showed 25.0% of solid contents by spindle.

No. 2018. *Ruländer*, from Mission San José. Received October 26, 1893, in fair condition. The bunches were very small and close; the berries small, juicy, thin-skinned, and of a dull purple-gray. The grapes were mature, and the must showed 28.6% of solid contents by spindle. This sample was fermented with No. 2017, Gewürz Traminer, from Mission San José.

No. 2098. *Ruländer*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The bunches were small, compact, with thick peduncles; the berries small, juicy, soft, shriveled, and overripe. The must showed 31.1% of solid contents by spindle.

FRANKEN RIESLING.

(See Vit. Rept, 1885–86, p. 98.)

Synonyms: Sylvaner blanc; Plant du Rhin.

The Franken Riesling is chiefly grown in the Austrian empire, but also on the Rhine, and in Alsace and France, where it bears the name of *Plant du Rhin*, *Auxerrois*, and many others. It is, therefore, a widely spread variety, and is especially adapted to the cooler and more exposed locations and poorer soils, where other vines would yield but an indifferent product. As its wine is rich in gummy ingredients, it is customary to ferment it with other good varieties, such as the true Riesling, Traminer, etc., in order to prevent its passing into the mucous fermentation. For the same reason, it is desirable to aërate the must before fermentation. The vine is easily recognized by its light green, round leaf, which is scarcely lobed.

Description.—Vine strong-growing and productive, with thick, erect, and somewhat short-jointed canes; leaves of medium size, round, puffy, entire or with two shallow lateral sinuses closed by the overlapping of the lobes, almost glabrous on both sides, teeth short and unequal; bunches of medium size, cylindrical or slightly conical, compact, on short, thick peduncles; berries of medium size, round or deformed by pressure, firm, thick-skinned, punctate.

This variety has been rather extensively planted in California, and in some places has given good results. As distributed in this State it is often mixed with a large-leaved, very vigorous-growing variety, which nearly always loses its crop by coulure. The true Franken Riesling is a vigorous grower, with ample foliage, and, when long-pruned, a fair bearer. At Cupertino, with long-pruning, it has yielded an average of four and a half tons per acre, and with short-pruning only one tenth of that amount. Like most of the German varieties in California, it attains a higher percentage of sugar than in Germany; in acid, it generally runs higher than the Traminer and lower than the Johannisberger—about the same as the Zierfahndler.

Its average composition has been: at Cupertino, 23.6% of sugar and 0.43% of acid; at Mission San José, 21.1% of sugar and 0.48% of acid; at Paso Robles, 23.0% of sugar and 0.46% of acid. The must is somewhat difficult to ferment and slow in clearing, and it gives a wine of full flavor, though much less marked than that of the Johannisberger, but requires the addition of some better fermenter to produce the best results. In its native habitat it is usually associated with the true Riesling, the Traminer, and the Elbling.

TABLE OF PRODUCTION.

FRANKEN RIESLING.	Number of Vines....	Total Weight of Grapes, in lbs......	Average per Vine, in lbs.	Date of Picking ..
1887—No. 699 (long-pruned). J. T. Doyle, Cupertino....	20	166	8.3	Oct. 5
No. 713 (short-pruned). J. T. Doyle, Cupertino...	20	20	1.0	Oct. 10
1888—No. 897 (long-pruned). J. T. Doyle, Cupertino....	8	148	18.5	Oct. 9
No. 898 (short-pruned). J. T. Doyle, Cupertino...	20	30	1.5	Oct. 9
1889—No. 1129. J. T. Doyle, Cupertino..................	20	250	12.5	Oct. 1

Analyses of Musts and Wines.

FRANKEN RIESLING.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at 6 to 8 Months	Volatile Acid	Body	Ash	Sugar
1883—No. 94. Charles Krug, St. Helena	......	20.16	20.24	.52	.42	9.02	11.22	.38	......	1.57	.29	......
1885—No. 342. J. Gallegos, Mission San José	......	21.47	......	.56	.39	8.48	10.58	.60	.37	3.82	.27	.65
No. 365. D. C. Feely, Patchen	......	21.16	......	.45	.32	9.05	11.27	.35	......	1.80	.16	......
1886—No. 474. J. Gallegos, Mission San José	Sept. 10	19.70	......	.59	.33	......	......	......	......	......	......	......
No. 491. J. T. Doyle, Cupertino	Sept. 21	18.60	18.58	.51	.27	7.09	8.85	.56	......	1.80	......	......
1887—No. 699 (long-pruned). J. T. Doyle, Cupertino	Oct. 5	23.83	24.01	.45	.40	10.26	12.73	.60	.09	2.30	......	......
No. 713 (short-pruned). J. T. Doyle, Cupertino	Oct. 10	26.06	26.12	.40	.46	......	......	......	......	......	......	......
1888—No. 885. J. Gallegos, Mission San José	Oct. 2	22.15	21.96	.30	.35	7.64	9.54	.60	......	1.80	......	......
No. 897 (long-pruned). J. T. Doyle, Cupertino	Oct. 9	24.36	25.19	.32	.37	10.07	12.54	.55	......	2.00	......	......
No. 898 (short-pruned). J. T. Doyle, Cupertino	Oct. 9	23.56	23.81	.31	.38							
No. 929 (Riesling). W. G. Klee, Santa Cruz	Oct. 22	20.29	20.24	1.08	.25	8.20	10.25	.68	......	2.70	......	......
1889—No. 1129. J. T. Doyle, Cupertino	Oct. 1	25.10	24.97	.48	.31	10.26	12.73	.33	......	2.05	......	......
1890—No. 1273. J. T. Doyle, Cupertino	Sept. 29	21.92	......	.50	.24	8.91	11.09	.33	......	1.80	......	......
1891—No. 1494. Paso Robles	Sept. 13	20.40	......	.48	......	......	......	......	......	......	......	......
No. 1501. Asti, Sonoma County	Sept. 22	24.40	23.90	.50	.40	9.92	12.36	.38	......	2.05	......	......
1892—No. 1642. Paso Robles	Sept. 13	23.70	......	.48	......	......	......	......	......	......	......	......
No. 1734. Paso Robles	Oct. 11	25.90	......	.32	......	......	......	......	......	......	......	......
1893—No. 1805. Amador station	Aug. 29	21.70	......	.64	......	......	......	......	......	......	......	......
No. 1883. Paso Robles	Sept. 19	21.50	20.24	.55	.32	7.09	8.85	.50	......	1.80	......	......
No. 2035. J. T. Doyle, Cupertino	Oct. 30	25.45	......	.46	......	......	......	......	......	......	......	......
1894—No. 2284. Amador station	Oct. 4	26.30	......	.51	......	......	......	......	......	......	......	......

RECORD OF TREATMENT.

No. 699. *Franken Riesling*, from J. T. Doyle, Cupertino. Received October 6, 1887, in good condition. The grapes were from long-pruned vines. The bunches were of fair size, the berries large and characteristically spotted. There were very few dried berries and very little coulure. The must showed 23.83% of solid contents by spindle and 0.45% of acid. The temperature of the grapes at crushing was 70°, and the maximum, reached on the third day, was 87°. The fermentation was over on the fourth day. During the fermentation the wine was thoroughly aërated once a day.

At two weeks the wine was drawn off the thick lees, and at two months it was bright, showed good Riesling aroma, and medium acid. Three weeks later the microscope showed the lees to be unsound, so the wine was racked off and pasteurized. The wine after this improved and remained clear for four or five months, after which it deteriorated.

No. 713. *Franken Riesling*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 14, 1887, in excellent condition. The grapes were from short-pruned vines. The bunches were loose and showed a considerable amount of coulure; the berries were of extra size, with the exception of a few abortive ones, and there were fewer dried and shriveled berries than in the long-pruned sample. The must showed 26.06% of solid contents by spindle and 0.40% of acid.

No. 885. *Franken Riesling*, from J. Gallegos, Mission San José. Received October 5, 1888, in fair condition. The bunches were cylindrical and compact, the berries large. The must showed 22.15% of solid contents by spindle and 0.30% of acid. The temperature of the grapes at crushing was 67.5°, and the maximum, reached on the third day, was 80°. The fermentation was over on the tenth day, and the wine was drawn off the thick lees.

At one month the wine was racked and taken to the cellar. At three months it was nearly clear, with marked and very pleasant aroma. Two months later the wine was pasteurized, as the lees showed unsound ferments. At eight months, when the wine was racked for the third time, it was in good order and of pleasing flavor, but little bouquet. Two months later it was in good order, pleasing, clean-tasting, and of fair quality, but lacking in bouquet. After this the wine improved, developed some bouquet, and was at its best at about sixteen months.

No. 897. *Franken Riesling*, from J. T. Doyle, Cupertino. Received October 10, 1888, in good condition and fully ripe. The bunches, which were typical, showed very little coulure, but some dried grapes. The must showed 24.36% of solid contents by spindle and 0.32% of acid. The grapes, which were from long-pruned vines, were mixed with No. 898, the same variety from short-pruned vines, and fermented, as shown in the record given below.

No. 898. *Franken Riesling*, from J. T. Doyle, Cupertino. Received October 10, 1888, in good condition. The grapes, which were from short-pruned vines, showed more coulure than the sample from long-pruned vines. The must showed 23.56% of solid contents by spindle and 0.31% of acid. The temperature of the grapes at crushing was 76°, and the maximum, reached on the third day, was 85°. Mixed with No. 897 and fermented, with the following record:

Nos. 897 and 898. At three weeks the wine was racked and taken to the cellar. At three months it showed high quality. Two months later it was pasteurized. At ten months it was clear, rather too yellow in color, with marked and agreeable flavor and bouquet, good body, acid, and alcohol. Three months later it was still very good, but slightly pricked. It remained good until the age of sixteen months, after which it deteriorated, on account of the smallness of the sample.

No. 929. *Riesling*, from W. G. Klee, Glenwood, Santa Cruz County. Received October 24, 1888, in good condition. The bunches were small and loose; the berries small, round, and spotted. The grapes showed a little coulure. The must showed 20.29% of solid contents by spindle and 1.08% of acid. The temperature of the grapes at crushing was 70°, and the maximum, reached on the fourth day, was 81°. The must fermented slowly, and at three weeks it was nearly through and was racked off.

At one month the wine was taken to the cellar. At three months the wine tasted green and did not show much aroma; at this time it was pasteurized. At six months the wine was racked for the third time, and at ten months it was in good condition, of light golden color, clean taste, pleasing flavor, and full acid; it had developed a good bouquet. At fourteen months it tasted nearly mature. At sixteen months the wine was very good, and tasted mature, was rather light, and had very full acid; in general, it was very agreeable, and a good imitation of a Rhine wine. Five months later the wine retained its good quality. At two years it was bottled. At twenty-seven months the bottled wine was clear and agreeable, but rather thin. Some wine which had been bottled at six months and rebottled at seventeen months showed more character of flavor and aroma, but was not quite clean-tasting. Eighteen months later both wines were good, but the second bottling was the better.

No. 1129. *Franken Riesling*, from J. T. Doyle, Cupertino. Received October 3, 1889, in very good condition, and completely mature. The bunches varied in size and compactness; the berries were of unequal size, but generally above the average. The must showed 25.1% of solid contents by spindle and 0.48% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 85°, on the second day. The wine was dry on the fifth day, when it was drawn off the thick lees.

At seven weeks the wine was nearly clear, of very light color, smooth, and agreeable; it was racked and taken to the cellar. At three months it was in good condition, without marked flavor or aroma, but agreeable, solid, and sound. At seven months it was racked for the third time, and was bright and sound. At fifteen months it was perfectly bright and sound, had developed a good bouquet, and tasted very clean and mature. Two months later it was bottled in part, and at twenty-two months the rest was bottled. At twenty-nine months the wine bottled at seven and that bottled at twenty-two months had deteriorated, but that bottled at seventeen months was very good. One year later the last wine was little changed, but was good, though lacking in bouquet.

No. 1273. *Franken Riesling*, from J. T. Doyle, Cupertino. Received October 2, 1890, in fair condition, a few rotten and moldy bunches; grapes of fair size, and mature. The must showed 21.92% of solid contents by spindle. The fermentation lasted seven days, reaching the maximum temperature of 80° on the fourth day.

The wine cleared slowly, and fermented gently for several weeks. At two months from crushing it had been racked twice, but was not quite clear; it was smooth, with good body and moderate acid. At three months it was racked again, but was not perfectly clear. At five months the lees showed a few lactic filaments, but the taste was unaffected; it was pasteurized for safety. Even after pasteurizing it was slow in clearing, and remained flat and insipid for some time. At fourteen months the taste had improved slightly, but the wine was not quite clear and had no bouquet. At sixteen months the wine was bottled. At twenty-seven months the bottled wine was bright, but flat and exhausted.

No. 1494. *Franken Riesling*, from Paso Robles station. A sample for must analysis was received September 16, 1891, in good condition, and mature. The must showed 20.4% of solid contents by spindle.

No. 1501. *Franken Riesling*, from Asti, Sonoma County. Received September 25, 1891, in good condition. The must showed 24.4% of solid contents by spindle. The fermentation was cool and prolonged, reaching a maximum temperature of 79° on the third day, and lasting over ten days.

At one month the wine was quite dry, but still cloudy. At two months it was nearly clear and full flavored. At three months it was racked for the third time, being clear, but still very raw and undeveloped. At five months it was bright and much improved, was smooth and pleasing, with full bouquet and flavor. At sixteen months it was bottled, being still a good wine, but with a somewhat suspicious after-taste.

No. 1642. *Franken Riesling*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 23.7% of solid contents by spindle.

No. 1734. *Franken Riesling*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 25.9% of solid contents by spindle.

No. 1805. *Franken Riesling*, from Amador station. A sample for must analysis arrived September 1, 1893, in good condition. The bunches and berries were small and fairly well flavored; a few grapes were sunburned. The must showed 21.7% of solid contents by spindle.

No. 1883. *Franken Riesling*, from Paso Robles station. Received September 21, 1893, in good condition. The bunches were small and compact; berries of medium size, soft, and with little flavor. The grapes were mature, but not very sweet. The must showed 21.5% of solid contents by spindle. The fermentation lasted eight days, reaching its maximum temperature of 78° on the second day.

In three weeks the wine was clear, and was racked for the second time. At four months the wine was bright, of good bouquet and flavor, and generally a very smooth and agreeable wine. At eight months it had been racked three times; it was very good, and showed signs of maturing quickly.

No. 2035. *Franken Riesling*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were compact and under medium size; the berries over medium size, pulpy, with good, but not high flavor; the grapes were mature. The must showed 25.45% of solid contents by spindle.

ORLEANS.

Synonyms: Orleaner; Gros Riesling; Orleans Riesling.

Description.—Vine fairly vigorous when grown on suitable soil; leaves of medium size, longer than wide, glabrous on both surfaces, except for some rough hairs on the nerves below, three to five lobed, the upper sinuses very deep, the lower scarcely marked; bunches of medium size, conico-cylindrical, somewhat close; berries over average size, slightly ovoid, juicy, but with firm flesh and rather thick skin; without special aroma; ripening in the second epoch, a week or two after the Riesling.

This variety is grown throughout the Palatinate and the Rhingau, but above all at Rudesheim, where it makes wines which are only second to those of the true Rieslings in celebrity. It is one of the most anciently known grapes of Germany, but has been very generally replaced by the Johannisberger. It is, in general, a better bearer than the true Rieslings, and does not require long-pruning.

At the Amador station it has shown itself to be a moderate grower, with upright canes, and a good, regular bearer. It succeeds there better in a granite soil, with a northern exposure, than in a warmer red soil. At Tulare, in an alkali soil, it is a poor grower, and though it shades its grapes well and produces good-sized, well-filled bunches, the crop is small and the must is very deficient in acid.

Analyses of Musts.

	Date of Picking.	Solid Contents by Spindle.	Acid as Tartaric.
1893—No. 2031. Cupertino	Oct. 29	26.50	.54
1894—No. 2141. Amador station	Sept. 11	26.50	.47
No. 2311. Tulare	Oct. 11	24.90	.24

KLEINBERGER.

(See Vit. Rept. 1885-86, p. 95.)

Synonyms: Weisser Elbling; Putzscheer; Gouais blanc.

Description.—Vine strong-growing and durable, with rough bark; leaves large, coarse, slightly or not at all lobed, round, dark green above, a little woolly below; bunches of medium size, conical, compact or often loose, and with many small, abortive berries; berries over medium size, thin-skinned, very juicy, without special flavor, and ripen about the third period.

This is one of the most widely distributed varieties in the northern and central wine-growing districts of Europe, and owes its popularity principally to its heavy-bearing qualities. It is the true white Burger of Germany, and has, in some respects, given more satisfaction here than the California Burger. It bears less here and requires long-pruning, but gives a wine of higher quality.

At Cupertino the average crop of long-pruned vines has been 5 tons per acre, and of short-pruned vines only 1.7 tons. In Tulare the crop has been light for the locality, viz., 3.6 tons; at the Amador station it has proved a fair bearer.

In Germany the grapes attain but a very low percentage of sugar with very high acid, but here they generally develop more sugar and less acid than the Burger. In the central coast counties it ranges from 22% to 26% of sugar and 0.45% to 0.60% of acid. At Tulare it has averaged 24% of sugar and 0.48% of acid; at the Amador station it goes even higher in sugar, with an equal amount of acid.

The best results with this variety have been obtained at Mission San José, where it makes a good, clean wine, without much character, but fermenting easily, maturing early, and developing some bouquet. At Tulare it makes a fair wine, but no better than others which produce larger crops.

One of its greatest defects is the thinness of the skin of the grape, which renders it very susceptible to damage from bad weather or rough handling.

TABLE OF PRODUCTION.

KLEINBERGER.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 715 (long-pruned). J. T. Doyle, Cupertino	20	110	5.5	Oct. 11
No. 764 (short-pruned). J. T. Doyle, Cupertino	20	20	1.0	Oct. 20
1888—No. 865 (short-pruned). J. T. Doyle, Cupertino	19	153	8.0	Sept. 26
No. 866 (long-pruned). J. T. Doyle, Cupertino	20	440	22.0	Sept. 26
1889—No. 1106. J. T. Doyle, Cupertino	20	320	16.0	Sept. 25

ANALYSES OF MUSTS AND WINES.

KLEINBERGER.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at 6 to 8 Months	Body	Ash
1886—No. 488. J. T. Doyle, Cupertino	Sept. 21	17.60	17.22	.49	.25	6.75	8.46	.47	1.80	......
1887—No. 715 (long-pruned). J. T. Doyle, Cupertino	Oct. 11	23.40	23.61	.42	.42	9.70	12.09	.39	2.60	......
No. 764 (short-pruned). J. T. Doyle, Cupertino	Oct. 18	24.70	......	.52	......	Blended with No. 761.				
1888—No. 865 (short-pruned). J. T. Doyle, Cupertino	Sept. 26	22.69	23.13	.46	.36	8.70	10.83	.46	2.60	......
No. 866 (long-pruned). J. T. Doyle, Cupertino	Sept. 26	21.35	21.14	.44	.36	8.34	10.42	.52	2.05	......
1889—No. 1088. J. Gallegos, Mission San José	Sept. 17	23.70	24.12	.55	.38	9.63	12.00	.53	2.85	......
No. 1106. J. T. Doyle, Cupertino	Sept. 26	23.90	24.12	.45	.36	9.92	12.36	.53	2.50	......
1890—No. 1222. Margherita Vineyard, Fresno	Aug. 22	23.05	23.13	.54	.33	......	......	......	......	......
No. 1282. J. T. Doyle, Cupertino	Oct. 1	20.60	......	.50	.31	8.84	11.00	.40	2.32	......
No. 1299. J. Gallegos, Mission San José	Oct. 4	23.70	......	.60	......	......	......	......	......	......
1891—No. 1578. Mission San José	Oct. 13	26.50	24.96	.50	.36	10.35	12.82	.49	2.55	......
1892—No. 1645. Paso Robles	Sept. 13	21.50	......	.69	......	......	......	......	......	......
No. 1712. Mission San José	Oct. 3	24.35	24.20	.63	.33	8.70	10.83	.79	2.85	......
1893—No. 1880. Paso Robles	Sept. 14	19.50	18.58	.59	.30	7.23	9.00	.60	2.10	......
No. 1981. Tulare	Oct. 16	24.35	23.21	.50	.50	9.20	11.45	.57	3.10	......
No. 1990. Mission San José	Oct. 18	23.50	22.67	.63	......	9.05	11.27	.62	2.20	......
No. 2100. J. T. Doyle, Cupertino	Nov. 4	25.90	......	.53	......	......	......	......	......	......
1894—No. 2144. Amador station	Sept. 11	27.10	......	.47	......	......	......	......	......	
No. 2242. Mission San José	Oct. 3	23.90	......	.45	......	......	......	......	......	......
No. 2341. Tulare	Oct. 17	24.80	......	.39	......	......	......	......	......	......

RECORD OF TREATMENT.

No. 715. *Kleinberger*, from J. T. Doyle, Cupertino. Received October 12, 1887, in fair condition, somewhat crushed. The grapes were crushed the day they arrived, and the must showed 23.4% of solid contents by spindle and 0.42% of acid. The grapes were from long-pruned vines. The normal berries were large, but were mixed with a great many small ones, showing late coulure to the extent of about 50%; they were very sweet, juicy, and with little acid, and some were dried up. The temperature of the grapes at crushing was 70°, and the maximum reached was 78°, on the third day. On the eighth day the wine was dry.

On the eighteenth day the wine was drawn off the thick lees. At two months it was bright, with good aroma, medium acid, and light body, altogether a good, well-flavored wine. A month later it was racked again. At eight months the wine had not improved; it was clear, but had a suspicious taste. A microscopic examination of the lees showed the presence of filaments, so the wine was racked and pasteurized, but did not improve afterward.

No. 764. *Kleinberger*, from J. T. Doyle, Cupertino. Received October 20, 1887, in fair condition, and crushed the following day. The bunches were nearly all very small, and the berries very uneven in size and degree of ripeness; some grapes were very large and many were small and abortive, some were overripe, and some underripe and very green and acid. The must showed 24.7% of solid contents by spindle and 0.52% of acid. The must was blended with No. 761.

No. 865. *Kleinberger*, from J. T. Doyle, Cupertino. Received September 28, 1888, in good condition. The grapes were from short-pruned vines. The bunches were well filled and the grapes ripe. The must showed 22.69% of solid contents by spindle and 0.46% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 83°, on the third day. The wine was drawn off the heavy lees on the seventh day, though it was still fermenting a little.

No. 866. *Kleinberger*, from J. T. Doyle, Cupertino. Received September 28, 1888, in fair condition, and mature. The grapes were from long-pruned vines; they were crushed the day they arrived. The bunches were very uneven as regards form and size, and showed some late coulure; the berries varied much as to size and degree of ripeness. The must showed 21.35% of solid contents by spindle and 0.44% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 84°, on the third day. The wine was drawn off the heavy lees on the eighth day, though still fermenting very slowly.

At one month the wine was racked again and taken to the cellar. At three months it was still cloudy, but tasted agreeable; it was better than No. 865, and gave promise of being a good blending wine. Two months later it was racked again and the lees examined. A month later it was not quite clear, but had developed some bouquet. At eleven months it was clear but not bright, very light colored, with marked bouquet and pleasing flavor, clean-tasting, and in general good. Four months later some wine which had been kept in a demijohn was tasted, and found to be almost as good as that in the keg, but not quite clean-tasting. At seventeen months it was bright, fresh, and clean-tasting, much better than No. 865, which had deteriorated, owing, doubtless, to the small size of the keg in which the latter was kept. At this date it was racked again, and four months later a microscopic examination of the lees showed them to be quite sound. At this date the wine was in good condition, and was of fairly good quality, with good bouquet.

No. 1088. *Kleinberger*, from J. Gallegos, Mission San José. Received September 19, 1889, in rather poor condition, and crushed the same day. The bunches were of medium size, cylindrical, and close; the berries large but unequal, round, with thin and tender skin, soft, juicy, and mature. The must showed 23.7% of solid contents by spindle and 0.55% of acid. The temperature of the grapes at crushing was 72°, and the maximum reached was 83°, on the third day. The wine was quite dry on the sixth day, and was drawn off the thick lees.

At one month the wine was nearly clear and showed some aroma, but was not very agreeable to the taste. At six weeks it was racked and taken to the cellar. At four months an examination of the lees showed them to be sound. At six months the wine was racked again, and at nine months it was bright and of fair quality, of good flavor, but lacking in bouquet, and not quite clean-tasting. Later, the wine deteriorated.

No. 1106. *Kleinberger*, from J. T. Doyle, Cupertino. Received September 27, 1889, in good condition, but rather overripe. The grapes agreed with Pulliat's description, but were rather irregular. The must showed 23.9% of solid contents by spindle and 0.45% of acid. The temperature of the must at crushing was 65°. The must was fermented in a keg surrounded by a jacket of water, which was kept at a temperature of 65°. The maximum temperature reached by the must was 70°, on the fourth day. On the fourth day the wine was transferred to another keg and put in the cellar.

At three weeks the wine was racked. At five weeks it was bright, of very light greenish color, of faint but agreeable bouquet, neutral flavor, and clean taste. At two months it was racked again. At four months it was in good condition, somewhat deeper in color than at last tasting, of good quality. The lees were examined at four and at eight months, and found to be sound. At eight months the wine was racked again, and at nine months it was clear, with pleasing bouquet and flavor, agreeable acid, and in general a good wine. At eleven months is was racked again; it was still good, but had a slight taste of mold. At sixteen months it was bright, with little bouquet, good flavor, body, and alcohol. At seventeen months the wine bottled at nine months was bright and equal to that in the keg, but had a little more of the moldy taste. At this date the wine was all bottled. A year later the wine first bottled showed that but for the moldy taste it would have been an excellent light wine of neutral character. The wine bottled later was cleaner-tasting and very drinkable, though with little character.

No. 1222. *Kleinberger*, from Margherita Vineyard, Fresno. A sample for must analysis arrived August 23, 1890, in fairly good condition, slightly overripe. The must showed 23.05% of solid contents by spindle.

No. 1282. *Kleinberger*, from J. T. Doyle, Cupertino. Received October 3, 1890, in very bad condition, many grapes moldy and rotten. The must showed 20.6% of solid contents by spindle. The fermentation was slow, and lasted about twelve days; it reached its maximum temperature of 82° on the third day.

Three weeks after crushing the wine was nearly clear, but had a moldy taste. At two months it was clear and the moldy taste was much diminished. At three months the wine was bright, and had been racked three times. At six months it was bright and tasted sound, but a little flat. At fourteen months it was much improved, was well flavored, mature, and with a little bouquet. At sixteen months some of it was bottled, and the rest at twenty months. At two years both wines were clear, but not bright; they were smooth and drinkable, but without distinctive character; that bottled at sixteen months was not quite clean-tasting.

No. 1299. *Kleinberger*, from Mission San José. A sample for must analysis arrived October 6, 1890, in very bad condition—too moldy to be worth making into wine. The must showed 23.7% of solid contents by spindle.

No. 1578. *Kleinberger*, from Mission San José. Received October 16, 1891, in poor condition. The must showed 26.5% of solid contents by spindle. The fermentation lasted five days, reaching its maximum temperature of 82° on the third day.

In one month the wine was bright and showed good flavor and body. At five months it showed signs of maturing quickly, developed some bouquet, and was, in general, a good wine. It was racked four times during the first year, and at fourteen months tasted quite mature and was in first-class condition. At fifteen months it was bottled.

No. 1645. *Kleinberger*, from Paso Robles station. A sample for must analysis arrived September 16, 1892, in good condition. The must showed 21.5% of solid contents by spindle.

No. 1712. *Kleinberger*, from Mission San José. Received October 6, 1892, in poor condition; nearly all the grapes were small and abortive. The must showed 24.35% of solid contents by spindle. The fermentation lasted nine days, and the maximum temperature of 80° was reached on the fourth day.

At one month the wine was clear and fresh-tasting. It was racked twice during the first three months, at the end of which time it was bright, with good bouquet, but little flavor, full acid; generally, a light, clean-tasting wine, of fair quality. At five months it showed signs of a slight acetification, due to the smallness of the sample. It was bottled at fourteen months.

No. 1880. *Kleinberger*, from Paso Robles station. Received September 16, 1893, much bruised, but not moldy, of good size, and the bunches well filled; mature, but lacking in sweetness. The must showed 19.5% of solid contents by spindle. The fermentation lasted four days, and reached its maximum temperature of 82° on the second day.

The wine was clear in three weeks, when it was racked for the second time. At three months it was bright, with some flavor and a little bouquet, good acid, and clean taste. At seven months, one month after the third racking, it was bright, pleasant, and showed signs of a quick maturity.

No. 1981. *Kleinberger*, from Tulare station. Received October 18, 1893, in good condition. The bunches were close and of medium size; the berries of medium size, thin-skinned, juicy, ripe, and with little flavor. The must showed 24.35% of solid contents by spindle. The fermentation was cool, and lasted five days.

At one month after crushing the wine was clear, with clean taste and good acid. At three months it was bright, with some bouquet and flavor, and in general the best of the Tulare white wines of this year, but, like the rest, lacking in freshness of taste. At six months it remained an agreeable wine, but had acquired a slight odor of acetic acid, on account of being in so small a keg.

No. 1990. *Kleinberger*, from Mission San José. Received October 19, 1893, in good condition. Bunches of medium size and close; berries of medium size, soft, thin-skinned, very juicy, mature. The must showed 23.5% of solid contents by spindle. The fermentation lasted five days, attaining its maximum temperature of 81° on the third day.

The wine was clear at one month, and was racked twice during the first three months, at the end of which time it was bright, clean-tasting, with little character, but fresh and with pleasing acid. After the third racking, at six months, it showed little change, but had a faintly bitter after-taste.

No. 2100. *Kleinberger*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, compact, with a good many abortive berries; berries small to over-medium, thin-skinned, very juicy, sweet, mature. The must showed 25.9% of solid contents by spindle.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF WHITE RHENISH TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Johannisberg Riesling.								
487	Cupertino	1886	20.40	18.48	.65	.27	9.73	.60	1.80
742	Cupertino. (Long-pruned)	1887	21.24	20.24	.43	.40	11.00	.54	2.30
741	Cupertino. (Short-pruned)	1887	23.49	------	.50	.36	------	------	------
874	Cupertino	1888	22.05	23.13	.35	.31	11.18	.47	2.10
875	Cupertino	1888	22.40	22.67	.41	.29			
1139	Cupertino	1889	23.60	23.62	.60	.36	11.91	.52	1.57
1264	Cupertino	1890	22.15	------	.66	.26	12.18	.42	2.40
2033	Cupertino	1893	25.70	------	.65	------	------	------	------
862	Mission San José	1888	23.96	23.61	.46	.33	------	------	------
1068	Mission San José	1889	21.95	21.38	.43	.31	10.58	.55	2.07
1777	Mission San José	1892	22.60	------	.62	------	------	------	------
1994	Mission San José	1893	22.20	------	.60	------	------	------	------
1490	Paso Robles	1891	24.55	------	.36	------	------	------	------
632	St. Helena	1886	------	------	------	------	11.73	.56	2.10
652	Napa	1886	------	------	------	------	11.91	.61	1.30
538	Patchen	1886	19.30	18.29	.36	.26	8.85	.55	1.80
663	Oakville	1886	------	------	------	------	12.50	.38	2.60
	Average, Cupertino	------	**22.64**	**21.63**	**.54**	**.32**	**11.20**	**.49**	**2.03**
	Average, Mission San Jose	------	**22.68**	**22.49**	**.42**	**.32**	**10.58**	**.55**	**2.07**
	Red Traminer.								
1075	Cupertino	1889	26.40	26.31	.41	.41	13.91	.50	2.65
2099	Cupertino	1893	28.30	------	.31	------	------	------	------
1211	Fresno	1890	25.90	25.76	.52	.39	------	------	------
1304	Mission San José	1890	25.10	------	.38	.39	12.82	.42	2.15
2017	Mission San José	1893	25.65	24.53	.38	.26	13.73	.38	3.10
1542	Paso Robles	1891	23.70	------	.36	------	------	------	------
1810	Amador station	1893	23.50	------	.50	------	------	------	------
	Average, Cupertino	------	**27.35**	**26.31**	**.36**	**.41**	**13.91**	**.50**	**2.65**
	Average, Mission San Jose	------	**25.38**	**24.55**	**.38**	**.33**	**13.28**	**.40**	**2.67**
	Ruländer.								
1217	Fresno	1890	25.20	24.64	.41	.31	------	------	------
1274	Cupertino	1890	23.36	------	.56	.29	12.64	.36	2.28
2098	Cupertino	1893	31.10	------	.48	------	------	------	------
1315	Mission San José	1890	26.50	------	.45	.24	15.00	.36	2.44
2018	Mission San José	1893	28.60	28.02	.50	.20	------	------	------
2231	Mission San José	1894	25.35	------	.55	------	------	------	------
1802	Amador station	1893	25.00	------	.56	------	------	------	------
2281	Amador station	1894	24.35	------	.50	------	------	------	------
	Average, Cupertino	------	**27.23**	------	**.52**	**.29**	**12.64**	**.36**	**2.28**
	Average, Mission San Jose	------	------	**28.02**	**.50**	**.22**	**15.00**	**.36**	**2.44**
	Average, Amador station	------	**24.68**	------	**.53**	------	------	------	------
	Franken Riesling.								
94	St. Helena	1883	20.16	20.24	.52	.42	11.22	.38	1.57
342	Mission San José	1885	21.47	------	.56	.39	10.58	.60	3.82
474	Mission San José	1886	19.70	------	.59	.33	------	------	------
885	Mission San José	1888	22.15	21.96	.30	.35	9.54	.60	1.80
365	Patchen	1885	21.16	------	.45	.32	11.27	.35	1.80
491	Cupertino	1886	18.60	18.58	.51	.27	8.85	.56	1.80
699	Cupertino. (Long-pruned)	1887	23.83	24.01	.45	.40	12.73	.60	2.30

Summary of Analyses of Musts and Wines of White Rhenish Type—Continued.

			MUST.			WINE.			
Number	LOCALITY.	Vintage of	Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
713	Cupertino. (Short-pruned)	1887	26.06	26.12	.40	.46	------	------	------
897	Cupertino. (Long-pruned)	1888	24.36	25.19	.32	.37	12.54	.55	2.00
898	Cupertino. (Short-pruned)	1888	23.56	23.81	.31	.38			
1129	Cupertino	1889	25.10	24.97	.48	.31	12.73	.33	2.05
1273	Cupertino	1890	21.92	------	.50	.24	11.09	.33	1.80
2035	Cupertino	1893	25.45	------	.46	------	------	------	------
929	Santa Cruz	1888	20.29	20.24	1.08	.25	10.25	.68	2.70
1494	Paso Robles	1891	20.40	------	.48	------	------	------	------
1642	Paso Robles	1892	23.70	------	.48	------	------	------	------
1734	Paso Robles	1892	25.90	------	.32	------	------	------	------
1883	Paso Robles	1893	21.50	20.24	.55	.32	8.85	.50	1.80
1501	Asti, Sonoma County	1891	24.40	23.90	.50	.40	12.36	.38	2.05
1805	Amador station	1893	21.70	------	.64	------	------	------	------
2284	Amador station	1894	26.30	------	.51	------	------	------	------
	Average, Cupertino	------	------	**23.78**	**.43**	**.33**	**11.59**	**.47**	**1.99**
	Average, Mission San Jose	------	------	**21.96**	**.48**	**.36**	**10.06**	**.60**	**2.61**
	Average, Paso Robles	------	**22.87**	**20.40**	**.46**	**.32**	**8.85**	**.50**	**1.80**
	Average, Amador station	------	**24.00**	------	**.58**	------	------	------	------
	Orleans.								
2031	Cupertino	1893	26.50	------	.54	------	------	------	------
2141	Amador station	1894	26.50	------	.47	------	------	------	------
2311	Tulare	1894	24.90	------	.24	------	------	------	------
	Kleinberger.								
488	Cupertino	1886	17.60	17.22	.49	.25	8.46	.47	1.80
715	Cupertino. (Long-pruned)	1887	23.40	23.61	.42	.42	12.09	.39	2.60
764	Cupertino. (Short-pruned)	1887	24.70	------	.52	------	------	------	------
865	Cupertino. (Short-pruned)	1888	22.69	23.13	.46	.36	10.83	.46	2.60
866	Cupertino. (Long-pruned)	1888	21.35	21.14	.44	.36	10.42	.52	2.05
1106	Cupertino	1889	23.90	24.12	.45	.36	12.36	.53	2.50
1282	Cupertino	1890	20.60	------	.50	.31	11.00	.40	2.32
2100	Cupertino	1893	25.90	------	.53	------	------	------	------
1088	Mission San José	1889	23.70	24.12	.55	.38	12.00	.53	2.85
1299	Mission San José	1890	23.70	------	.60	------	------	------	------
1578	Mission San José	1891	26.50	24.96	.50	.36	12.82	.49	2.55
1712	Mission San José	1892	24.35	24.20	.63	.33	10.83	.79	2.85
1990	Mission San José	1893	23.50	22.67	.63	------	11.27	.62	2.20
2242	Mission San José	1894	23.90	------	.45	------	------	------	------
1222	Fresno	1890	23.05	23.13	.54	.33	------	------	------
1645	Paso Robles	1892	21.50	------	.69	------	------	------	------
1880	Paso Robles	1893	19.50	18.58	.59	.30	9.00	.60	2.10
1981	Tulare	1893	24.35	23.21	.50	.50	11.45	.57	3.10
2341	Tulare	1894	24.80	------	.39	------	------	------	------
2144	Amador station	1894	27.10	------	.47	------	------	------	------
	Average, Cupertino	------	**22.52**	**21.84**	**.47**	**.34**	**10.86**	**.46**	**2.31**
	Average, Mission San Jose	------	**24.27**	**23.99**	**.56**	**.36**	**11.73**	**.61**	**2.61**
	Average, Paso Robles	------	**20.50**	**18.58**	**.64**	**.30**	**9.00**	**.60**	**2.10**
	Average, Tulare	------	**24.57**	**23.21**	**.44**	**.50**	**11.45**	**.57**	**3.10**

WHITE BURGUNDY TYPE.

The fine white wines of Burgundy have a reputation which is hardly second to that of Sauterne or Rhine wines. They do not possess the marked and peculiar aroma which the latter obtain from the highly flavored Riesling and Sauterne grapes from which they are made. They are, however, wines of extreme delicacy of flavor, of great smoothness, full body, and high bouquet. The famous Montrachet takes rank with Château-Iquem and Johannisberger, while the wines of Chablis and Pouilly are of world-wide renown. The best of these wines are made from the Pinot blanc Chardonay grown at medium elevations on hillsides. The Chardonay loses its high character if grown on moist valley soils or in the warmest localities. The indications are that excellent wines of this type will be made in some of the coast counties, especially in warm, well-drained locations in late localities. The grapes ripen early and more evenly than the Semillon, but must be well cared-for to avoid sunburn and drying up. On the whole, the white Burgundy grapes have shown much more promise for California than the red; and the wines do not present the same difficulties in handling and aging.

PINOT BLANC.

Synonyms: Plant doré blanc; Auvernat blanc.

Description.—This grape is simply a white-fruited variation of the ordinary Franc Pinot, which it resembles almost exactly in all characters except the color of the grapes.

It is a true Pinot with all the characteristics of growth and habit of that group, and succeeds under the same conditions. Its product resembles that of the Chardonay, but is inferior to it in all respects. Its average crop at Cupertino has been about one and a half tons per acre. The grapes ripen earlier than those of the Chardonay, are inferior in flavor, but develop a higher sugar content; the average must composition has been: at Cupertino, 26.5% of sugar and 0.56% of acid; at Mission San José, 25.5% of sugar and 0.66% of acid. In Sonoma it attains even higher sugar content, and, like its congener, Pinot noir, fails to retain sufficient acid. The wine is not very robust, and, in general, seems to have no good qualities in which it is not surpassed by the Chardonay.

TABLE OF PRODUCTION.

PINOT BLANC.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 777. J. T. Doyle, Cupertino	20	12	0.6	Oct. 25
1888—No. 845. J. T. Doyle, Cupertino	9	42	4.6	Sept. 13
1889—Row 46. J. T. Doyle, Cupertino	9	65	7.2	Sept. 20

Analyses of Musts and Wines.

PINOT BLANC.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric at 6 to 8 Months	Body
1887—No. 777. J. T. Doyle, Cupertino	Oct. 25	30.00	29.83	.50	.60	------	------	------	------
1888—No. 845. J. T. Doyle, Cupertino	Sept. 13	21.50	22.05	.45	.28	9.70	12.09	.51	2.60
1889—No. 1122. J. Gallegos, Mission San José	Sept. 30	25.90	26.12	.56	.35	*	------	------	------
1890—No. 1337. J. T. Doyle, Cupertino	Oct. 10	25.90	------	.50	------	------	------	------	------
1891—No. 1517. Mission San José	Sept. 30	25.10	25.20	.75	.35	10.81	13.27	.57	2.10
No. 1593. A. Macartney, Los Guilicos	Oct. 16	26.80	25.19	.42	.36	12.15	14.90	.35	2.20
1892—No. 1621. Tulare	Aug. 28	25.20	------	.39	------	------	------	------	------
1893—No. 1944. Tulare	Oct. 15	25.00	------	.45	------	------	------	------	------
No. 2027. J. T. Doyle, Cupertino	Oct. 29	27.65	------	.78	------	------	------	------	------
1894—No. 2327. Tulare	Oct. 15	26.00	------	.42	------	------	------	------	------

* For analysis of wine, see No. 1121, Pinot Chardonay, from J. Gallegos, Mission San José.

Record of Treatment.

No. 777. *Pinot blanc*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 26, 1887, in fair condition. The bunches were very uneven in size, and showed much early coulure; the berries showed very uneven ripening. The must showed 30.0% of solid contents by spindle and 0.50% of acid.

No. 845. *Pinot blanc*, from J. T. Doyle, Cupertino. Received September 14, 1888, in good condition. The bunches showed much early coulure. The must showed 21.5% of solid contents by spindle and 0.45% of acid. The fermentation lasted seven days, and reached its maximum temperature of 84° on the third day.

At three weeks the wine was racked for the second time and taken to the cellar. At four months it was nearly clear, of light aroma, pleasant acid and flavor, but not quite clean-tasting. The wine was pasteurized. At seven months it was clear and sound, and was racked again. At seventeen months it was bright and showed high quality, and was mature. A month later it was bottled. A year after bottling it was bright, of full and agreeable flavor, little bouquet, and lacking in freshness. At four years it was a very smooth, full-bodied wine, but rather lacking in bouquet and freshness.

No. 1122. *Pinot blanc*, from J. Gallegos, Mission San José. Received October 1, 1889, in good condition, and mature. The bunches were small, cylindrical, and loose, on thick peduncles, the berries of medium size. The must showed 25.9% of solid contents by spindle. It was fermented with No. 1121, Pinot Chardonay, from Mission San José.

No. 1337. *Pinot blanc*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in fair condition. The must showed 25.9% of solid contents by spindle.

No. 1517. *Pinot blanc*, from Mission San José. Received October 1, 1891, in good condition, and mature. The must showed 25.1% of solid contents by spindle. The fermentation lasted eleven days, and reached a maximum temperature of 77° on the fourth day.

At one month from crushing the wine was clear, but still a little sweet. At three months it had been racked twice, and was clear, fresh, and fruity, with some bouquet and flavor. At five months it was bright, with good aroma, but somewhat raw. At seven months it had been racked three times, and was in good condition, very fresh and richly flavored, but without very much bouquet. It was racked again at eleven months, and at sixteen months it was bottled.

No. 1593. *Pinot blanc*, from A. Macartney, Los Guilicos. Received October 19, 1891, in fair condition, mature, a little moldy. The fermentation was prolonged, lasting over two weeks; the maximum temperature of 80° was reached on the fifth day.

The wine remained slightly sweet for over a month, but in six weeks was clear and clean-tasting. At five months it had been racked three times, and was bright, very fruity, and of high quality. At ten months it was racked for the fourth time. At sixteen months it was in good order, full-bodied, of high flavor and marked character; its only defect was a slight bitterness. A month later it was bottled.

No. 1621. *Pinot blanc*, from Tulare station. A sample for must analysis arrived September 1, 1892, in good condition. The must showed 25.2% of solid contents by spindle.

No. 1944. *Pinot blanc*, from Tulare station. A sample for must analysis arrived October 18, 1893, in good condition. The bunches were very small, irregular, and loose; the berries small, sunburned, and tasteless. The must showed 25.0% of solid contents by spindle.

No. 2027. *Pinot blanc*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The bunches were small, short, conico-cylindrical, close; the berries small, juicy, sweet, mature. The must showed 27.65% of solid contents by spindle.

PINOT BLANC CHARDONAY.

Synonyms: Melon; Epinette.

Description.—Vine more vigorous than most of the Pinots, with slender, yellowish, short-jointed canes; leaves small to medium, yellowish green, scarcely lobed and coarsely toothed; bunches small, conico-cylindrical, and compact; berries small, spherical, and with more flavor than the true Pinot blanc.

The grapes ripen a week or two later than those of the black Pinots. It is from this grape that the famous white wines of Montrachet, Chablis, and Pouilly are made. It is sometimes confused with the true Pinot, from which, however, it differs in its period of ripening (which is nearly two weeks later), the firmer flesh, and somewhat larger size of its berries, and its more pronounced flavor. It is said in France to be a less prolific bearer than the true Pinot blanc, but in California the contrary seems to be true.

The vine is a vigorous grower, free from disease, shades its grapes well, and does well on almost any well-drained soil, even on those which are too poor for most grapes. In rich valley soils it tends to go too much to wood, and requires very long canes. It is particularly suited to the northern coast counties; in Napa it is reported as producing from three to five tons per acre, doing best on the higher lands. The average crop for three years at Cupertino was 3.4 tons per acre. The average composition of the must at Cupertino and Mission San José has been 24.0% of sugar and 0.50% of acid. In the more southerly and central stations the sugar has been higher and the acid too low.

In the rich Tulare soils the crops have been small, and the grapes flavorless and injured by the sun. The wine obtained from this grape in suitable localities is well flavored, with good bouquet and body and sufficient alcohol. The points of superiority of this grape over the true Pinot Blanc are its better bearing qualities (in California), its superior aroma, and its greater adaptability to various soils.

TABLE OF PRODUCTION.

PINOT CHARDONAY.	Number of Vines....	Total Weight of Grapes, in lbs.....	Average per Vine, in lbs.	Date of Picking....
1887—No. 776 (long-pruned). J. T. Doyle, Cupertino...	20	141	7.0	Oct. 25
1888—No. 849 (long-pruned). J. T. Doyle, Cupertino...	12	127	10.5	Sept. 17
1889—No. 1110 (long-pruned). J. T. Doyle, Cupertino...	10	120	12.0	Sept. 26

ANALYSES OF MUSTS AND WINES.

PINOT CHARDONAY.

	Date of Picking	MUST. Solid Contents by Spindle	MUST. Sugar by Copper Test	MUST. Acid as Tartaric	WINE. Ash	WINE. Alcohol. By Weight	WINE. Alcohol. By Volume	WINE. Total Acid as Tartaric at Six to Eight Months	WINE. Volatile Acid	WINE. Body
1887—No. 776. J. T. Doyle, Cupertino	Oct. 23	25.65	25.19	.48	.32	9.70	12.09	.57	.05	2.60
1888—No. 849. J. T. Doyle, Cupertino	Sept. 17	21.50	22.05	.45	.28	8.34	10.42	.38	......	2.45
No. 858. J. Gallegos, Mission San José	Sept. 24	24.24	24.54	.48	.39	9.92	12.36	.61	......	2.80
1889—No. 1110. J. T. Doyle, Cupertino	Sept. 26	23.50	23.62	.41	.29	9.63	12.00	.53	......	2.10
No. 1121. J. Gallegos, Mission San José	Sept. 29	25.00	24.97	.45	.42	10.16*	12.64	.45	......	2.55
1890—No. 1375. J. T. Doyle, Cupertino	Oct. 14	21.30	......	.70	......	......	......	......	......	......
No. 1357. J. Gallegos, Mission San José	Oct. 11	24.80	......	.53	......	......	......	......	......	......
1891—No. 1520. J. Gallegos, Mission San José	Sept. 29	22.75	......	.57	......	......	......	......	......	......
No. 1533. Paso Robles	Oct. 6	24.70	......	.30	......	......	......	......	......	......
1892—No. 1622. Tulare	Aug. 29	24.35	......	.47	......	......	......	......	......	......
No. 1735. Paso Robles	Oct. 10	25.90	......	.43	......	......	......	......	......	......
1893—No. 1840. Amador station	Sept. 4	22.40	......	.59	......	......	......	......	......	......
No. 1940. Tulare	Oct. 11	23.70	22.23	.43	.50	......	......	......	......	......
No. 2093. Cupertino	Nov. 5	25.50	......	.60	......	......	......	......	......	......
1894—No. 2161. Amador station	Sept. 19	26.10	......	.47	......	......	......	......	......	......
No. 2237. Mission San José	Oct. 5	23.70	......	.50	......	......	......	......	......	......
No. 2326. Tulare	Oct. 15	24.80	......	.35	......	......	......	......	......	......

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* Blended with No. 1122, Pinot blanc, from J. Gallegos, Mission San José.

RECORD OF TREATMENT.

No. 776. *Pinot Chardonay*, from J. T. Doyle, Cupertino. Received October 25, 1887, in fair condition. The bunches were of fair size and characteristic shape, well filled, but showing some early coulure; the berries were somewhat overripe and sunburned, very sweet, but with good acid. The must showed 25.65% of solid contents by spindle and 0.48% of acid. The temperature of the grapes at crushing was 76°, and the maximum reached was 84°, on the third day. The fermentation was over on the sixth day.

On the tenth day the wine was drawn from the lees. At eight weeks it was still a little cloudy, but showed good aroma and characteristic flavor; it was full-bodied and of medium acid. Three weeks later it was racked and pasteurized for safety. At three months and a half it was clear and had developed some bouquet; it had good body and full acid. At eight months the bouquet was much improved, but the wine was not quite clean-tasting.

No. 849. *Pinot Chardonay*, from J. T. Doyle, Cupertino. Received September 18, 1888, in fair condition. Most of the bunches were very compact, triangular, double shouldered or winged; some showed a great deal of early coulure and sunburn. The overripe and crushed berries were removed before crushing. The must showed 21.5% of solid contents by spindle and 0.45% of acid. The grapes were fermented with 11½ lbs. of the pomace of No. 835, Gamai Teinturier, from Cupertino, as a red wine.

At six weeks the wine was racked and taken to the cellar. At ten weeks it was clear, but lacking in color, showed good aroma, but was not quite clean-tasting. Seven weeks later it was pasteurized for safety. At eight and a half months it was racked and put in glass. It was clear and sound. At fifteen months it had improved, and tasted mature and finished. At seventeen months it was bright and sound, with faint bouquet and agreeable flavor, having the smoothness of a white wine. At two years and five months it had improved in bouquet, flavor, and general quality, and the color had become brighter.

No. 858. *Pinot Chardonay*, from J. Gallegos, Mission San José. Received September 25, 1888. The bunches were small and compact. The must showed 24.24% of solid contents by spindle and 0.48% of acid. The fermentation was made in a hot chamber at a temperature of 93°. The wine was poor from the start, and soon became quite spoiled.

No. 1110. *Pinot Chardonay*, from J. T. Doyle, Cupertino. Received September 27, 1889, in poor condition—crushed, shriveled, and overripe. The bunches were close and small to medium in size. The must showed 23.5% of solid contents by spindle and 0.41% of acid. The fermentation was violent, reaching a maximum temperature of 81.5° on the third day, and expelling much foam from the bung-hole.

In six weeks the wine was clear, with little aroma, but otherwise of very good quality. At four months it had improved; but as the lees showed unsound germs, the wine was pasteurized. Six weeks later it was bright, of pleasing flavor and delicate bouquet. At one year it was in good condition, of good bouquet, and mature. It was racked for the fourth time, and part put in bottle. Four months later the wine in wood was bright, of fine flavor, good body and acid, and well matured. The lees showed a good deal of *S. pastorianus*. At eighteen months the wine bottled at one year was bright, clean-tasting, and sound, of higher character than that in the keg; the rest was bottled at this time. A year later the wine first bottled was as good as before, while that bottled at eighteen months had deteriorated. At three years and five months little change was to be perceived in the wines.

No. 1121. *Pinot Chardonay*, from J. Gallegos, Mission San José. Received October 1, 1889, in fair condition. The bunches were very close and some of the berries dried up. The grapes were very ripe, and the must showed 25.0% of solid contents by spindle and 0.45% of acid. The grapes were fermented with No. 1122, Pinot blanc, from Mission San José, in equal proportions. The must reached its maximum temperature on the third day, and was dry on the sixth.

On the seventh day the wine was racked off the thick lees. In six weeks it was clear, of very light color, good aroma, marked flavor, medium acid, full alcohol and body; in general, of very pleasing character. At this date it was racked and taken to the cellar. At four months it was bright and well developed, but was not quite clean-tasting. Two months later it was bright and was racked for the third time. The lees were examined and no unsound germs found. They were examined again at ten and at fifteen months, and only a few acetic germs found. At eighteen months it was bright and of good bouquet and rich flavor, but somewhat injured by too much access of air. At this date the wine was put into glass. At two years and half the wine bottled at six months had deteriorated, while that bottled at eighteen months was bright and of good quality, but not of very high bouquet. A year later the wine had much improved in bouquet.

No. 1375. *Pinot Chardonay*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 17, 1890, in fair condition; a few grapes dried, maturity complete. The must showed 21.3% of solid contents by spindle.

No. 1357. *Pinot Chardonay*, from Mission San José. A sample for must analysis arrived October 14, 1890, in good condition, and mature. The bunches were well filled and the grapes agreed well with Pulliat's description. The must showed 24.8% of solid contents by spindle.

No. 1520. *Pinot Chardonay*, from J. Gallegos, Mission San José. A sample for must analysis arrived October 1, 1890, in good condition, and mature. The must showed 22.75% of solid contents by spindle.

No. 1533. *Pinot Chardonay*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in poor condition; very small, sunburned, and not properly ripened. The must showed 24.7% of solid contents by spindle.

No. 1622. *Pinot Chardonay*, from Tulare station. A sample for must analysis arrived September 1, 1892, in good condition. The must showed 24.35% of solid contents by spindle.

No. 1735. *Pinot Chardonay*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 25.9% of solid contents by spindle.

No. 1840. *Pinot Chardonay*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition. The bunches were small, cylindrical, and compact; the berries small, fleshy, tasteless, not quite mature. The must showed 22.4% of solid contents by spindle.

No. 1940. *Pinot Chardonay*, from Tulare station. A sample for must analysis arrived October 13, 1893, in good condition. The bunches were small, short-cylindrical, compact; the berries of medium size, slightly ovoid, flavorless, somewhat sun-dried. The must showed 23.7% of solid contents by spindle.

No. 2093. *Pinot Chardonay*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The bunches were small, compact, cylindrical, with a small wing or shoulder; the berries small, round, pulpy but soft, very sweet, but very few shriveled. The must showed 25.5% of solid contents by spindle.

SUMMARY OF ANALYSES OF MUSTS AND WINES, WHITE BURGUNDY TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric at 6 Months	Body
	Pinot blanc.								
777	Cupertino	1887	30.00	29.83	.50	.60	-------	-------	-------
845	Cupertino	1888	21.50	22.05	.45	.28	12.09	.51	2.60
1337	Cupertino	1890	25.90	-------	.50	-------	-------	-------	-------
2027	Cupertino	1893	27.65	-------	.78	-------	-------	-------	-------
1122	Mission San José	1889	25.90	26.12	.56	.35	-------	-------	-------
1517	Mission San José	1891	25.10	25.20	.75	.35	13.27	.57	2.10
1593	Los Guilicos	1891	26.80	25.19	.42	.36	14.90	.35	2.20
1621	Tulare	1892	25.20	-------	.39	-------	-------	-------	-------
1944	Tulare	1893	25.00	-------	.45	-------	-------	-------	-------
2327	Tulare	1894	26.00	-------	.42	-------	-------	-------	-------
	Average, Cupertino		**26.26**	**25.94**	**.56**	**.44**	**12.09**	**.51**	**2.60**
	Average, Mission San Jose		**25.50**	**25.66**	**.65**	**.35**	**13.27**	**.57**	**2.10**
	Average, Tulare		**25.40**	-------	**.42**	-------	-------	-------	-------
	Pinot blanc Chardonay.								
776	Cupertino	1887	25.65	-------	.48	.32	12.09	.57	2.60
849	Cupertino	1888	21.50	-------	.45	.28	-------	-------	-------
1110	Cupertino	1889	23.50	-------	.41	.29	12.00	.53	2.10
1375	Cupertino	1890	21.30	-------	.70	-------	-------	-------	-------
2093	Cupertino	1893	25.50	-------	.60	-------	-------	-------	-------
858	Mission San José	1888	24.24	-------	.48	.39	12.36	.61	2.80
1121	Mission San José	1889	25.00	-------	.45	-------	-------	-------	-------
1357	Mission San José	1890	24.80	-------	.53	-------	-------	-------	-------
1520	Mission San José	1891	22.75	-------	.57	-------	-------	-------	-------
2237	Mission San José	1894	23.70	-------	.50	-------	-------	-------	-------
1533	Paso Robles	1891	24.70	-------	.30	-------	-------	-------	-------
1735	Paso Robles	1892	25.90	-------	.43	-------	-------	-------	-------
1622	Tulare	1892	24.35	-------	.47	-------	-------	-------	-------
1940	Tulare	1893	23.70	-------	.43	.50	-------	-------	-------
2326	Tulare	1894	24.80	-------	.35	-------	-------	-------	-------
1840	Amador station	1893	22.40	-------	.59	-------	-------	-------	-------
2161	Amador station	1894	26.10	-------	.47	-------	-------	-------	-------
	Average, Cupertino		**23.49**	-------	**.53**	**.29**	**12.04**	**.55**	**2.35**
	Average, Mission San Jose		**24.09**	-------	**.51**	**.39**	**12.36**	**.61**	**2.80**
	Average, Paso Robles		**25.30**	-------	**.66**	-------	-------	-------	-------
	Average, Tulare		**24.38**	-------	**.42**	**.50**	-------	-------	-------
	Average, Amador station		**24.25**	-------	**.53**	-------	-------	-------	-------

SAUTERNE TYPE.

The attempt to reproduce European types of wines in California has been particularly successful in the case of Sauternes, and there is little doubt that if we could afford to exercise the minute care of some of the wine-makers of the Gironde, some of our products would equal their "premiers crus." It is a well-recognized fact in the Sauternes district that the superiority of the "premiers crus" over the "deuxièmes crus" is due, in most cases, principally to the exercise of greater care and skill, and not to superiority of soil or location. Vineyards which formerly produced wines of second quality, now, by the adoption of better methods, are made to produce wines of first quality. This plainly indicates the direction in which our efforts to improve our Sauternes should tend. Though we will probably never find it profitable to gather the grapes berry by berry, as is done at Château-Iquem, we may very much improve the average quality of our grapes by intelligent pruning and cultivation of the vines. Even the selection of bunches is at present impracticable with the unpracticed pickers who must usually be employed.

One of the most important objects to be kept in view, therefore, is uniformity in the ripening of the grapes. This is almost impossible by the ordinary method of pruning the vines to a head and tying the long canes up to a stake. By this method the grapes on different parts of the vine are exposed to very different conditions of light, heat, and moisture. This is particularly the case with the Sauterne varieties, on account of their heavy foliage and their habit of producing both on the spurs and on the canes. Some method of training, therefore, should be adopted which will place every bunch as nearly as possible under the same conditions of exposure. This is probably most easily and economically obtained by the use of a single wire at about fifteen inches from the soil, to which the vines are tied. The Sauterne varieties lend themselves very readily to this method of training, and the greater regularity of bearing, as well as of ripening, amply repay the extra outlay.

The Semillon, Sauvignon blanc, and Muscadelle are the varieties from which, here as in France, the finest Sauternes are made. For good wines of the second grade a certain proportion of Sauvignon vert is without doubt an improvement on Folle blanche, which is used for this purpose in France.

SEMILLON.

(See Vit. Rept. 1883-85, p. 119; 1885-86, p. 92.)

Synonyms: Colombier; Chevrier; Goulu blanc.

Description.—Rather vigorous; canes semi-erect, vigorous, long, slightly flattened, mahogany colored, and with fairly long internodes; leaves large, thick, three or five lobed; petiolar sinus U-shaped, lower lateral sinuses deep; teeth short, unequal, generally obtuse; upper surface pale green, glabrous, wavy; lower surface slightly downy; bunch large, well filled, conico-cylindrical, winged; berries of good size, nearly round, transparent and of a fine golden color when mature, sweet, thin-skinned, and with a marked and agreeable flavor. The grapes ripen in the second epoch.

The Semillon is perhaps the most famous of the French white grapes, uniting excellence of quality with abundance of production in a more marked degree than any other variety. Mixed with the Sauvignon and the Muscadelle, it produces the highest class Sauternes. The vines have unfortunately the defect of starting too soon, and thus being exposed to injury by frost; they are also subject to rots, but resist *Peronospora* well. The soil best suited to this variety is a strong, calcareous clay on a gravelly marl subsoil.

This grape has given satisfaction in more localities in California than perhaps any other white variety that has been tried. It is especially valuable in the warmer parts of the coast valleys. It has been planted somewhat extensively in Napa, Sonoma, Santa Clara, and Alameda, proving itself a vigorous grower, shading its grapes well, a reliable bearer, though at times subject to coulure, comparatively free from disease, and easy to graft upon resistant stocks. It has produced satisfactory crops, both with long and with half-long pruning; it is especially adapted to the curved-cane system of pruning, which is practiced in the Sauterne district, where this variety originated. In France it is often pruned short, but with the wide planting usual in California it requires long or half-long canes to yield satisfactory crops. It is reported as yielding from 1½ to 2 tons per acre on light hill soils, and from 4 to 5 tons per acre on rich and valley soils. The average yield for three years at the experimental plot in Santa Clara County was 3.68 tons per acre for the long-pruned and 1.21 tons for the short-pruned vines. At the Fresno and Tulare experimental plots the yield has been very small, not exceeding 1 ton per acre. In San Diego it is reported as a shy bearer.

The must is characterized, in general, by somewhat high sugar contents and low to medium acid; the wine is therefore very apt to retain a little sugar after fermentation, making it very suitable for the production of wines similar to the Sauternes which it produces in France. Notwithstanding its failure to ferment-out quite dry, it is not a difficult wine to handle. With proper care, and without the deplorably excessive use of sulphur fumes in which some wine-makers indulge, it may be brought into perfect condition. The large quantities of sulphurous acid with which some of our otherwise good California wines are impregnated cannot be too strongly deprecated, for it is not only injurious to their quality and wholesomeness, but is also unnecessary. The proof of this is that there are some most excellent California Sauternes on the market, which are quite or very nearly free from any sulphurous taint, showing that, at most, there has been but a very limited and reasonable use of sulphur fumes in their preparation, and that it is therefore possible, by careful handling, to avoid the use of any such excess as is now shown, even by some very prominent brands.

TABLE OF PRODUCTION.

SEMILLON.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 745 (long-pruned). J. T. Doyle, Cupertino	20	144	7.2	Oct. 16
No. 750 (long-pruned). J. T. Doyle, Cupertino	20	154	7.7	Oct. 18
No. 753 (short pruned). J. T. Doyle, Cupertino	20	47	2.3	Oct. 19
1888—No. 899 (short-pruned). J. T. Doyle, Cupertino	20	95	4.7	Oct. 8
No. 900 (long-pruned). J. T. Doyle, Cupertino	20	320	16.0	Oct. 8
1889—No. 1131 (half-long-pruned). J. T. Doyle, Cupertino	19	225	11.8	Sept. 29
Row 45 (long-pruned). J. T. Doyle, Cupertino	19	250	13.1	Oct. 2
Row 93 (half-long-pruned). J. T. Doyle, Cupertino	20	175	8.7	Oct. 1

Analyses of Musts and Wines.

SEMILLON.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
1883—No. 106.* J. H. Drummond, Glen Ellen						8.48	10.58	.38		1.52	.22
1884—No. 251. Natoma Wine Co., Natoma	Sept. 6	18.83	18.89	.54	.28						
No. 252. Natoma Wine Co., Natoma	Sept. 20	21.69	20.99	.42	.28	9.92	12.36	.45		1.93	18
1885—No. 339. H. Keatinge, Lower Lake		22.89		.55	.32						
No. 434.* J. B. Portal, San José						10.54	13.00	.51		1.80	.17
1886—No. 502. J. T. Doyle, Cupertino		18.40	18.29	.57	.23	7.16	8.93	.69			
1887—No. 745 (long-pruned). J. T. Doyle, Cupertino	Oct. 16	24.89	24.12	.50	.40	10.07	12.54	.52	.14	2.80	
No. 750 (long-pruned). J. T. Doyle, Cupertino	Oct. 18	24.04	22.23	.54	.43	9.12	11.36	.47	.05	2.60	
No. 753 (short-pruned). J. T. Doyle, Cupertino	Oct. 19	25.26	25.53	.44	.45	10.35	12.82	.66	.06	2.10	
1888—No. 899 (short-pruned). J. T. Doyle, Cupertino	Oct. 8	23.54	24.34	.34	.41	9.20	11.45	.54		2.60	
No. 900 (long-pruned). J. T. Doyle, Cupertino	Oct. 8	22.81	22.85	.34	.42	9.05	11.27	.44		2.35	
1889—No. 1015. Margherita Vineyard, Fresno	Aug. 17	26.90	26.99	.31	.60						
No. 1131. J. T. Doyle, Cupertino	Sept. 29	24.10	24.64	.41	.27	10.44	12.91	.44		2.30	
1890—No. 1216. Margherita Vineyard, Fresno	Aug. 23	25.90	24.10	.32	.35						
No. 1329. J. T. Doyle, Cupertino	Oct. 10	23.70		.57							
1891—No. 1556. Paso Robles	Oct. 6	26.90		.38							
1892—No. 1648. Paso Robles	Sept. 13	22.15		.51							
No. 1668. Tulare	Sept. 16	24.00	24.64	.36	.45	10.07	12.54	.59		3.30	
No. 1739. Paso Robles	Oct. 10	25.50		.39							
No. 1657. Amador station	Sept. 16	23.65		.48							
1893—No. 1798. Tulare	Aug. 30	21.50	20.24	.50	.28	7.64	9.50	.50			
No. 1818. Amador station	Sept. 7	20.90	19.89	.63	.28						
No. 2030. J. T. Doyle, Cupertino	Oct. 30	24.55		.60							
1894—No. 2155. Tulare	Sept. 17	25.20		.35							
No. 2158. Amador station	Sept. 19	26.90		.38							

* Wines sent for examination.

RECORD OF TREATMENT.

No. 745. *Semillon*, from J. T. Doyle, Cupertino. Received October 18, 1887, in fair condition. The grapes were from long-pruned vines. Many of the berries were dry or half-dried and some crushed, but none moldy. The bunches were of good size, well shouldered, and with little or no coulure. The must showed 24.89% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 75°, and the maximum reached was 89°, on the second day. The fermentation was over on the twelfth day, and the wine was drawn off on the fourteenth.

At two months the wine showed a very pronounced aroma, but less marked than that of No. 750; the acid was very agreeable. A month later it was racked for the second time. At eight months it was pleasant and vinous, had developed some bouquet, was heavy-bodied, and with pleasing but rather low acid. The flavor was exceedingly agreeable, but not so marked as that of No. 750. Two weeks later the lees showed some unsound germs, so the wine was drawn off and pasteurized. At ten months the wine was in good condition, with characteristic and fairly developed bouquet, of medium acid and alcohol; on the whole, very pleasing.

No. 750. *Semillon*, from J. T. Doyle, Cupertino. Received October 19, 1887, in good condition. The grapes were from long-pruned vines of another row than No. 745. The grapes were in good condition, and more highly flavored than those of No. 745. The must showed 24.04% of solid contents by spindle and 0.54% of acid. The temperature of the grapes at crushing was 73°, and the maximum reached was 83°, on the second day. The must was aërated twice on the second and third days, and once on the third and fourth. In six days the wine was nearly dry and clear.

In ten days the wine was drawn off the lees. At two months it was slightly cloudy, with good aroma and medium acid. At three months it was racked for the second time, and at four months racked and pasteurized. At eight months it was bright, with pronounced and characteristic aroma, heavy body, and pleasant acid; wine soft and pleasing, but almost too highly flavored.

No. 753. *Semillon*, from J. T. Doyle, Cupertino. Received October 20, 1887, in good condition. The grapes were from short-pruned vines, and were somewhat larger and less dried-up than the grapes from long-pruned vines; they also showed less coulure and more delicate flavor. The must showed 25.26% of solid contents by spindle and 0.44% of acid. The temperature of the grapes at crushing was 78°, and the maximum reached was 81.5°, on the third day. The fermentation was over on the tenth day.

At two weeks the wine was drawn off the thick lees and taken to the cellar. At two months it was still cloudy, but soft, clean-tasting, and sound; its aroma and flavor were well marked, but more delicate than those of the wines from long-pruned vines. At three months the wine was racked for the second time, and at six months, as the lees showed some unsound ferments, it was racked again and pasteurized. On account of the smallness of the quantity, it was put in glass. At eight months it was bright, with well-developed and characteristic bouquet, somewhat high and sharp acid for Semillon, heavy-bodied, and not quite clean-tasting.

No. 899. *Semillon*, from J. T. Doyle, Cupertino. Received October 10, 1888, in fair condition. The grapes were from short-pruned vines, and showed a great deal of early coulure; some bunches had dried and half-dried berries. The must showed 23.54% of solid contents by spindle and 0.34% of acid. The temperature of the grapes at crushing was 76°, and the maximum reached was 83°, on the third day. Fermentation was over on the twelfth day, when it was drawn off.

At one month the wine was racked off and taken to the cellar. At three months it was clear, of good aroma, medium body; in general, pleasing and sound. Two months later the lees showed some unsound germs, so the wine was drawn off and pasteurized. At eight months it was racked again; it showed more flavor and aroma than No. 900, and had developed well since the last tasting. At sixteen months an examination of the lees showed no unsound germs; the wine was bright and tasted mature, but had developed very little bouquet. A month later it was put into glass. At two years and four months it was bright, clean-tasting, smooth, and agreeable, but without very marked flavor or bouquet. At three years the wine had made some deposit in the bottles, so it was rebottled. Six months later the wine was bright, had made little deposit, showed good bouquet, flavor, body, and alcohol. At four years it was a well-developed, rich wine, of fine character.

No. 900. *Semillon*, from J. T. Doyle, Cupertino. Received October 10, 1888, in good condition. The grapes were from long-pruned vines, and showed less coulure than No. 899, and fewer dried berries. The must showed 22.81% of solid contents by spindle and 0.34% of acid. The temperature of the grapes at crushing was 77°, and the maximum reached was 85°, on the third day. Fermentation was over on the twelfth day, when the wine was drawn off.

At one month the wine was racked and taken to the cellar. At three months it was almost clear, of medium acid, full alcohol, and fair aroma. Two months later a microscopical examination of the lees showed no unsound germs, and the wine was racked for the third time. At ten months it was not quite bright, but showed some bouquet and agreeable flavor; general quality, smooth and good. At thirteen months the wine was nearly bright; some wine in bottle was clear and sound, but undeveloped. At sixteen months the microscope showed the lees to be sound; the wine was bright, improved in bouquet and flavor, and nearly mature. It was at this time superior to No. 899, which was in a smaller keg. Two weeks later it was racked again. At twenty-one months the lees showed a few bitter germs, but the wine was bright, of fine amber color, rich bouquet and flavor, clean-tasting, and mature. After this, as the wine was not bottled, it deteriorated.

No. 1015. *Semillon*, from Fresno. A sample for must analysis was received August 20, 1889, perfectly ripe, but in bad condition. The grapes were typical in appearance, but had little of the characteristic flavor of the variety. The must showed 26.9% of solid contents by spindle and 0.31% of acid.

No. 1131. *Semillon*, from J. T. Doyle, Cupertino. Received October 1, 1889, in fair condition. The grapes were typical in appearance and fully ripe, some of the berries being dried. The must showed 24.1% of solid contents by spindle and 0.41% of acid. The grapes were fermented with No. 1134, Sauvignon blanc, from Cupertino. The temperature of the grapes at crushing was 70°, and the maximum reached was 81.5°, on the third day. The wine was dry on the fourth day, and was drawn off. The proportion in which the grapes were mixed was Semillon six sevenths and Sauvignon one seventh.

In two months the wine was clear, of very light color, full and agreeable flavor, but not very marked aroma, clean taste, medium acid, and good body. At this time the wine was racked for the second time and taken to the cellar. Six weeks later the wine was in good condition, of very pleasing flavor, and generally improved and promising. The lees were examined under the microscope, and found to be sound. The lees were examined again at nine and at fifteen months, and no unsound germs found. At eight months the wine was bright, clean-tasting and good, but not very well developed. At fifteen months it had developed some bouquet, and was a wine of high quality. At seventeen months some wine which had been put in glass at seven months was tasted; it was bright and had made no deposit, but it was not as well developed as the wine in wood. At this date the wine was racked again, and some put in bottles. The rest was bottled at twenty months. At two years and five months the wine bottled at seven months showed very full and characteristic flavor and aroma, but was not quite clean-tasting. That bottled at seventeen months was less marked in character, but very smooth and pleasing; the wine bottled later was not quite equal to the latter. A year later the wine bottled at seventeen months retained its high quality, and had changed little.

No. 1216. *Semillon*, from Margherita Vineyard, Fresno. A sample for must analysis arrived August 25, 1890, in somewhat damaged condition, and overripe. The juice showed 25.9% of solid contents by spindle.

No. 1329. *Semillon*, from Cupertino. Arrived October 13, 1890, in fair condition; some dried berries. The sample was for must analysis only; solid contents by spindle, 23.7%.

No. 1556. *Semillon*, from Paso Robles station. Arrived October 8, 1891, in fair condition. The sample was for must analysis only; small bunches of fair-sized berries, a little sunburnt, mature. Solid contents by spindle, 26.9%.

No. 1648. *Semillon*, from Paso Robles station. A sample for must analysis only, arrived September 16, 1892, in good condition. Solid contents by spindle, 22.15%.

No. 1668. *Semillon*, from Tulare station. Arrived September 19, 1892, in good condition. The grapes were crushed the same day, and fermented with No. 1669, Sauvignon Vert, from the same locality. The must showed 24.0% of solid contents by spindle. Fermentation was somewhat slow, but thorough; attained its maximum of 82° on September 23d, and was through September 28th, when the wine was drawn off.

The wine was racked three times during the first year. At three months it was perfectly dry and bright, became slightly cloudy during the spring months, but cleared again and remained sound to the end. The wine was at first smooth and agreeable, of low acid, with some bouquet and flavor; at one year it was not so good, lacking somewhat in freshness and cleanness of after-taste.

No. 1739. *Semillon*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. Solid contents by spindle, 25.5%.

No. 1657. *Semillon*, from Amador station. A sample for must analysis arrived on September 19, 1892, in poor condition. Solid centents by spindle, 23.65%.

No. 1798. *Semillon*, from Tulare station. Received August 31, 1893, in good condition. Bunches of good size and fairly well filled; grapes rather soft and juicy, with little flavor. Must showed 21.5% of solid contents by spindle. Fermentation was quick, but cool, lasting five days and attaining a maximum temperature of 82°. On the sixth day from crushing the wine was drawn off.

The wine was clear, and was racked four weeks after crushing. At four months the wine was bright, with a little bouquet and flavor, fuller acid and fresher taste than most of the Tulare wines. After this it deteriorated, becoming *eventé*, on account of the small size of the keg.

No. 1818. *Semillon*, from Amador station. Received September 8, 1893, in good condition. Berries in small bunches, small, well colored, and of good but not pronounced flavor. Must showed 20.9% of solid contents by spindle.

No. 2030. *Semillon*, from J. T. Doyle, Cupertino. Arrived October 31, 1893, in good condition. Bunches and berries were of medium size; grapes juicy, thin-skinned, highly flavored, and mature. The sample was for must analysis only; solid contents by spindle, 24.55%.

SAUVIGNON BLANC.

(See Vit. Rept. 1883–85, p. 120.)

Synonyms: Sauvignon jaune; Blanc Fumé.

The Sauvignon is more widely distributed than the Semillon, as it forms not only an important ingredient of the wines of the Sauterne type in the Gironde, but is also well known southward to the Pyrenees, northward to the Loire, and eastward to the Rhone. Being only of fair vigor and rather a shy bearer, but of high quality, it is chiefly used in blending with both red and white wines of other varieties, to which it imparts its fine and delicate flavor, while at the same time losing the slight harshness that characterizes its wines during the first years. The Sauvignon is pruned short in the Sauterne district, and this should be done wherever the soil is not rich, as otherwise the vine will be too soon exhausted. It ripens somewhat after the middle of the season. At Natoma the grapes were gathered fairly ripe on September 6th, fully ripe on September 17th, with the Semillon, and overripe on September 30th.

Description.—Vine less vigorous than the Semillon, and with smaller canes; leaves medium to small, round, generally three-lobed, with closed sinuses, glabrous and dark green above and with a flocculent down below; bunches small, conico-cylindrical, close; berries of medium size, slightly oval, on slender pedicels, juicy, with thick but tender skin, and very aromatic flavor.

The Sauvignon has shown that it retains its distinctive and high quality at least in the coast counties of California, but its bearing has been deficient. It has not shown itself to be as well adapted to our conditions as the Semillon, and should only be planted in small quantity to give character to more neutral grapes. In the rich soils of the interior valleys it loses a great part of its character. It is pruned short in the Sauterne district, but seems to need long canes in California. The grapes ripen later than those of the Riesling and earlier than those of the Sauvignon vert; they easily and constantly attain a full percentage of sugar, and maintain their acid well, even in the San Joaquin Valley.

ANALYSES OF MUSTS AND WINES.

SAUVIGNON BLANC.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body
1884—No. 253. Natoma Wine Company, Natoma	......	21.66	21.22	.62	.31	10.26	12.75	.55	.19	2.18
No. 254. Natoma Wine Company, Natoma	......	22.20	20.99	.53	.29	9.92	12.36	.45	.16	2.10
1885—No. 335. H. Keatinge, Lower Lake	......	24.20	......	.59	......	......	......	......	......	......
1889—No. 1032. Margherita Vineyard, Fresno	Aug. 30	23.76	23.61	.79	.60	......	......	......	......	......
No. 1134.* J. T. Doyle, Cupertino	Oct. 2	26.10	26.12	.58	.37	......	......	......	......	......
1890—No. 1317. J. T. Doyle, Cupertino	Oct. 10	25.00	......	.58	.20	12.39	15.20	.48	......	2.12
1891—No. 1464. Fresno	Aug. 28	23.50	......	.76	.46	8.84	11.00	.53	......	2.74
1894—No. 2325. Tulare	Oct. 15	24.50	......	.35	......	......	......	......	......	......

* Fermented with No. 1131, Semillon.

RECORD OF TREATMENT.

No. 1032. *Sauvignon blanc*, from Margherita Vineyard, Fresno. A sample for must analysis was received September 2, 1889, in fair condition. The grapes, which were very ripe, were of typical appearance, but lacked the characteristic flavor of the variety. The must showed 23.76% of solid contents by spindle and 0.79% of acid.

No. 1134. *Sauvignon blanc*, from J. T. Doyle, Cupertino. Received October 3, 1889, in good condition, and mature. The bunches were small, cylindrical, and rather compact; the berries from small to average, slightly oval, with rather thick but tender skin, green, and covered with brownish spots; flesh tender and juicy, and with very marked flavor. The must showed 26.1% of solid contents by spindle and 0.58% of acid. The grapes were fermented with No. 1131, Semillon.

No. 1317. *Sauvignon blanc*, from J. T. Doyle, Cupertino. Received October 13, 1890, in rather poor condition. The must showed 25.0% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 80°, on the fourth day. The wine was drawn off the thick lees on the seventh day.

At three weeks the wine was still cloudy. At six weeks it was quite clear, had good aroma, full and pleasing flavor, medium acid, good body, and was generally of good quality. At four months the wine was racked for the second time. Examinations of the lees at six weeks and at three months showed no bad germs. At five months a few acetic germs were seen, but two months later the lees were quite sound. At six months the wine was bright, sound, and maturing well. At fifteen months it was in good order, showed full, rich bouquet and flavor, and was very characteristic, well matured, and of high quality. At seventeen months it was racked and part put in bottle; at twenty-two months the rest was bottled. At three years both bottlings were bright and had thrown no deposit. They both showed good bouquet and full, rich flavor; that bottled later was smoother and cleaner-tasting than the other, but deeper in color.

No. 1464. *Sauvignon blanc*, from Fresno. Received August 31, 1891, in fair condition. The must showed 23.5% of solid contents by spindle and 0.76% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 82°, on the third day. On the fifth day the wine was dry, and was drawn off the thick lees.

In two weeks the wine was nearly clear. At six weeks it was bright, showed some aroma, good flavor, clean taste, and good acid. At two months it was racked and taken to the cellar. At four months it was in good order, and showed good bouquet and flavor. The lees were examined microscopically at four and at seven months, and found to be sound. At seven months the wine was bright, sound, and pleasing; it was nearly mature, and at nine months it was bottled. The wine remained clear in the bottle, but became flat, owing partly to the smallness of the quantity made.

SAUVIGNON VERT.

(See Vit. Rept. 1885–86, p. 92.)

Synonyms: Green Riesling (Napa); Colombar (in California); Colombaud (?).

There is some doubt about the identity of the Sauvignon vert. In this State it is commonly called the Colombar, which is a mere corruption of Colombaud, a well-known French variety. The following description of the Colombaud is taken from Foëx: "Vine very vigorous; canes erect, thick, with medium internodes; leaves of average size, the petiolar sinus deep and almost closed, lateral sinus shallow, teeth sharp and in two series, the upper surface glabrous and almost shining, the lower surface slightly downy; bunch of average size, somewhat irregular, winged, and close; berries large, spherical, transparent, of a greenish-white, becoming yellow and a little rusty on the side exposed to the sun, thin-skinned, and agreeable to eat; they ripen somewhat late."

This description serves very well in most essentials for the Sauvignon vert as grown in California, though the form of the leaf is not quite as described. The Colombaud is, like most of the white vines of Provence, very hardy; it grows well, even in soils the least favorable to the vine. On account of its thin skin it rots easily in damp places, and it is subject to coulure in poor soils. It is best suited to rich, warm, well-drained soils. On account of its vigor, it resisted the phylloxera longer than almost any other variety in the south of France.

In California the Sauvignon vert has shown itself a very good bearer almost everywhere, except on heavy clay soils, where it is apt (especially if pruned short) to develop too much foliage and to be injured by *oidium*. Like the Semillon, it is at home in the hill soils of the coast valleys, where it gives large crops, which ripen well and develop high sugar with comparatively low acid. It gives a wine of high flavor and aroma, but not particularly robust, and which, unless blended, is difficult to keep. In Tulare and Fresno, on the contrary, it retains for the locality a relatively good amount of acid at maturity, and produces a wine of considerable merit with regard to quality, but as usual difficult to keep when pure.

Its bearing at Tulare has not been very satisfactory, being below two tons per acre. It might be used in that locality as a blend with neutral wines, on account of its marked flavor, but there are others more satisfactory for that purpose. When grown on well-drained, light soils, it produces an excellent wine of the Sauterne type, but when grown on richer soils the wine produced is lacking in keeping qualities. When grown under the conditions where it gives the best results, it produces an average of from three to five tons per acre. It has been noted by Mr. F. Swett, of Martinez, Contra Costa County, that this variety has the valuable quality of bearing grapes on canes from adventitious buds, thus insuring a crop even after the first growth of canes has been destroyed by frost. At the Paso Robles experiment station this variety has uniformly produced grapes with a particularly low percentage of acid, and is, therefore, not to be recommended for that locality as a grape for dry wines.

ANALYSES OF MUSTS AND WINES.

SAUVIGNON VERT.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body
1886—No. 490. J. T. Doyle, Cupertino		18.70	18.71	.42	.26	7.09	8.85	.53		1.75
1887—No. 697 (long-pruned). J. T. Doyle, Cupertino	Oct. 5	23.01	23.23	.39	.34	9.63	12.00	.75	.12	2.20
No. 708 (short-pruned). J. T. Doyle, Cupertino	Oct. 10	25.67	26.00	.47	.54	11.00	13.45	.44		2.60
No. 724. J. P. Smith, Livermore	Oct. 12	22.67	22.67	.30	.42	9.49	11.82	.47	.09	2.60
1888—No. 880 (short-pruned). J. T. Doyle, Cupertino	Oct. 3	21.39	21.38	.28	.40	7.92	9.90	.45		2 33
No. 881 (long-pruned). J. T. Doyle, Cupertino	Oct. 3	21.55	22.23	.27	.24					
1889—No. 1018. Margherita Vineyard, Fresno	Sept. 1	24.50	25.19	.46	.66					
No. 1095. Margherita Vineyard, Fresno	Sept. 18	21.50	21.38	.58	.48	8.84	11.00	.47		2.70
No. 1130. J. T. Doyle, Cupertino	Oct. 1	23.30	22.95	.38	.39	9.56	11.91	.40		2.40
1890—No. 1220. Margherita Vineyard, Fresno	Aug. 23	23.70	23.61	.47	.45					
No. 1275. J. T. Doyle, Cupertino	Sept. 30	19.30		.51	.24	8.20	10.25	.42		2.20
1891—No. 1433. Tulare	Aug. 25	20.85		.30	.61					
No. 1455. Fresno	Aug. 27	21.50		.68		8.91	11.09	.49		2.60
No. 1513. Calistoga	Sept. 27	24.25	21.38	.53	.35	10.54	13.09	.53		2.20
No. 1514. Asti, Sonoma County	Sept. 28	22.70	21.38	.44	.30	9.20	11.45	.53		2.55
No. 1540. Paso Robles	Oct. 6	25.55		.22						
1892—No. 1669. Tulare	Sept. 16	25.45	25.53	.37	.49					
No. 1733. Paso Robles	Oct. 10	23.70		.35						
1893—No. 1821. Amador station	Sept. 6	22.60	21.38	.59	.21					
No. 1847. Tulare	Sept. 13	23.70	21.80	.54	.51	9.20	11.45	.44		2.60
No. 1961. Paso Robles	Oct. 12	29.30		.32						
No. 2091. Cupertino	Nov. 5	24.10		.61						
1894—No. 2157. Amador station	Sept. 19	26.90		.38						
No. 2218. Paso Robles	Sept. 28	25.65		.30						
No. 2287. Tulare	Oct. 6	26.90	25.19	.38		10.35	12.82	.41		2.30

RECORD OF TREATMENT.

No. 697. *Sauvignon vert*, from J. T. Doyle, Cupertino. Received October 6, 1887, in good condition. The grapes were from long-pruned vines, and showed some coulure. Both bunches and berries were large, the latter very sweet and thin-skinned. The must showed 23.01% of solid contents by spindle and 0.39% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 89°, on the fourth day. The fermentation was over on the tenth day. At twelve days the wine was drawn off the thick lees.

At two months the wine was bright, with little aroma, medium acid, pleasant, smooth, and full-bodied. Five months later the lees showed some unsound germs, so the wine was drawn off and pasteurized. Six weeks after pasteurizing it was a bright, fine-flavored, and good wine, with pronounced bouquet, but rather sharp acid.

No. 708. *Sauvignon vert*, from J. T. Doyle, Cupertino. Received October 11, 1887, in good condition. The grapes were from short-pruned vines, and showed very little coulure. The bunches were large and full, contrasting favorably with those from the long-pruned vines; the berries were smaller, on the average, in the latter lot. The must showed 25.67% of solid contents by spindle and 0.47% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 81°, on the third day. In six days the fermentation was over.

At three weeks the wine was drawn off the lees. At two months it was still cloudy, but tasted sound; had light, pleasant acid and fair aroma. A microscopic examination of the lees showed no unsound germs. At three months the wine was racked again, and at eight months it was almost bright; it had developed some bouquet, and would have been a good wine but that it was not quite clean-tasting.

No. 724. *Sauvignon vert*, from J. P. Smith, Livermore. Received October 13, 1887, in good condition, although somewhat crushed in transit. The bunches were large and heavily shouldered, but showed some coulure. The berries were somewhat smaller than those of the same variety from Cupertino; they were very juicy, thin-skinned, and sweet. The must showed 22.67% of solid contents by spindle and 0.30% of acid. The temperature of the grapes at crushing was 69.5°, and the maximum reached was 85°, on the third day. In two weeks the fermentation was over. At eighteen days the wine was drawn off the lees.

At two months it was still cloudy, but sound and agreeable. At three months it was racked again. At five months it was racked for the third time and pasteurized. At eight months it was bright and sound; it showed moderate acid, heavy body, and some bouquet—altogether, a wine of very good quality.

Nos. 880 and 881. *Sauvignon vert*, from J. T. Doyle, Cupertino. Received October 5, 1888, in good condition. No. 880 was from short-pruned and No. 881 from long-pruned vines. The grapes from the long-pruned vines showed the most coulure. The must showed 21.39% of solid contents by spindle and 0.28% of acid for the short-pruned; and 21.55% of solid contents by spindle and 0.27% of acid for the long-pruned. The grapes were crushed and fermented together. The maximum temperature, reached the third day, was 86.5°, and the time of fermentation eleven days.

At one month the wine was racked and taken to the cellar. At three months it was clear and of good flavor and aroma; but as the lees were not quite right, the wine was pasteurized. Three months after pasteurizing it was racked and part put in bottle. At ten months it was bright, of light golden color, marked and agreeable flavor, medium acid, good body; rather astringent for a white wine, general quality good. At fourteen months the wine put in bottle at six months was perfectly sound, of agreeable character, and well developed. At sixteen months the lees were sound and the wine was in good order, of good bouquet and advanced development. A month later it was racked again, and a part bottled. At twenty-two months the rest of the wine was bottled; it was bright, smooth, and agreeable, with low acid; the lees were sound. At twenty-eight months the wine bottled at six months was clear, clean-tasting, and of good quality, except for the odor, which was not pleasing; that bottled at seventeen months had less flavor than the above; that bottled at twenty-two months was the only one that had made no deposit in the bottle, but it had less character than the others. At three years and ten months the wine bottled at seventeen months was much the best of the three; it was a wine of high quality, full flavor, and rich bouquet; it had deposited a slight but well-settled deposit.

No. 1018. *Sauvignon vert*, from Fresno. A sample for must analysis was received September 2, 1889, in fair condition. The grapes were overripe, and showed little of the characteristic flavor of the variety. The must showed 24.5% of solid contents by spindle and 0.46% of acid.

No. 1095. *Sauvignon vert*, from Fresno. Received September 20, 1889, in good condition. The grapes came from the Margherita Vineyard, and were less ripe than those from the experimental plot. The bunches were of medium size, cylindrical, and winged; the berries round, loose, soft, and juicy, of agreeable but not marked flavor, and with green, thin, but rather resistant skin. The must showed 21.5% of solid contents by spindle and 0.58% of acid. In five days the wine was nearly dry, the highest temperature of 82.5° being reached on the third day.

On the fifth day the wine was racked off, but left in the fermenting-room, as it was not quite dry. At one month it was still cloudy, but tasted sound, though somewhat insipid. At two months it was racked again and taken to the cellar. At four months the wine was still cloudy, insipid, and of poor quality, but without any very bad taste. The lees, however, showed some germs of unsoundness, and two months later, as the flavor was becoming affected, the wine was pasteurized. At nine months the wine was bright and much improved, but neither the odor nor the taste was quite clean. Two months later it was still in good condition, but was a wine of poor quality. After this it deteriorated.

No. 1130, *Sauvignon vert*, from J. T. Doyle, Cupertino. Received October 3, 1889, in good condition. The bunches were large and rather loose, well shouldered; berries unequal, but in general over-average, soft and very juicy, and with characteristic flavor. The must showed 23.3% of solid contents by spindle and 0.38% of acid.

At six weeks, when the wine was racked for the second time and taken to the cellar, it was nearly clear, of marked flavor and aroma, medium acid, good body, and clean taste. Two months later it was clear, smooth, and agreeable. At this time the lees showed a few unsound germs, and four months later the number had increased and the flavor was beginning to be affected, so the wine was pasteurized. A month after pasteurizing the wine was clear, and but little changed since the last tasting. Two months later it was bright, with good, full bouquet and flavor, clean taste, and in general much improved. At fifteen months it was bright and of good bouquet and flavor, but tasted a little exhausted. At eighteen months the wine bottled at ten months was tasted; it was sound and bright, and fresher and better than the wine in the keg. At this time the rest of the wine was bottled. At two years and five months both samples tasted somewhat thin. A year later the second bottling was smooth, full-bodied, and agreeable, but was lacking in bouquet.

No. 1220. *Sauvignon vert*, from Margherita Vineyard, Fresno. A sample for must analysis was received August 25, 1890, in good condition, but overripe. The must showed 23.7% of solid contents by spindle.

No. 1275. *Sauvignon vert*, from J. T. Doyle, Cupertino. Received October 2, 1890. Bunches and berries large; grapes juicy, wet from the rain, and slightly moldy. Must showed 19.3% of solid contents by spindle. The fermentation was cool and somewhat prolonged, attained a maximum temperature of 79° on the fourth day, and was nearly through eight days after crushing.

The wine was racked twice before the end of the year, cleared well, and developed some bouquet and flavor. At the end of January the lees showed a few unsound germs, and the wine was pasteurized for safety. The wine developed fairly well, acquired a good bouquet, but was somewhat deficient in flavor. At fourteen months the wine tasted mature, and some of it was bottled; at twenty-four months the rest was bottled. One year after bottling the wine was bright and in good order, but that last bottled was a little exhausted.

No. 1433. *Sauvignon vert*, from Tulare station. Received August 27, 1891, in good condition. A sample for must analysis showed 20.85% of solid contents by spindle.

No. 1455. *Sauvignon vert*, from Fresno. Received August 31, 1891, in good condition. The must showed 21.5% of solid contents by spindle. Fermentation lasted six days, attaining a maximum temperature of 80° on the fifth day.

The wine was racked at one and at four months from crushing; cleared rather slowly, but remained sound and developed some bouquet. At eight months the wine was not quite clear, showed some lactic germs in the lees, and did not taste quite clean; it was racked into a sulphured keg, and two months later was racked again. At two years the wine was bright and sound, but with little flavor and a slight taste of sulphur.

No. 1513. *Sauvignon vert*, from P. R. Schmidt, Calistoga. Received September 29, 1891, in good condition, and mature. The must showed 24.25% of solid contents by spindle. Fermentation was very slow and cool, and the wine was not dry till about one month after crushing.

The wine was clear at two months, and was racked at three months for the second time: it had high acid and was at first very harsh, but at five months the bouquet had developed remarkably. At fifteen months it was a fresh and pleasing wine, in first-rate condition, and mature, and was bottled.

No. 1514. *Sauvignon vert*, from Asti, Sonoma County. Received October 1, 1891, in poor condition—crushed and a little moldy. The grapes had none of the flavor of Sauvignon vert, and more resembled Orleans Riesling. The must showed 22.70% of solid contents by spindle. Fermentation was at its height on the fourth day, with a temperature of 77°, and was finished on the eighth day.

The wine was racked twice during the first three months; it cleared well, and gave promise of being a good wine. At five months it was bright, with rich bouquet and flavor, but somewhat raw. At fifteen months it had toned down, was mature, and of high quality. At sixteen months it was bottled.

No. 1540. *Sauvignon vert*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition; grapes mature, but sunburned. The must showed 25.55% of solid contents by spindle.

No. 1669. *Sauvignon vert*, from Tulare station. Received September 19, 1892, in good condition. The must showed 25.45% of solid contents by spindle. For fermentation record, see No. 1668, Semillon.

No. 1773. *Sauvignon vert*, from Paso Robles station. Sample for must analysis was received October 13, 1892, in good condition. The must showed 23.7% of solid contents by spindle.

No. 1821. *Sauvignon vert*, from Amador station. Received September 8, 1893. Fine, juicy grapes, but without much flavor. The must showed 22.6% of solid contents by spindle. The fermentation was very slow and protracted, and the wine was not in sufficient quantity to keep.

No. 1847. *Sauvignon vert*, from Tulare station. Received September 15, 1893. Bunches loose, but well filled, and of average size; the berries were of average size, mature, and well flavored. The must showed 23.7% of solid contents by spindle. The fermentation was prompt and thorough, attaining a maximum temperature of 83° on the second day, and finishing on the sixth day.

The wine cleared rapidly, and at three months, having been racked twice, was bright. At four months it showed marked bouquet and flavor, a slight bitterness, and more character than most of the Tulare wines. At seven months it still showed good qualities, but was not perfectly clean-tasting and fresh.

No. 1961. *Sauvignon vert*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in fair condition. Bunches were of medium size, and winged; berries thin-skinned, juicy, highly flavored, and mature. The must showed 29.3% of solid contents by spindle.

No. 2091. *Sauvignon vert*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. Bunches large, shouldered, a little coulured above; berries of medium size, soft, juicy, mature. The must showed 24.1% of solid contents by spindle.

FOLLE BLANCHE.

(See Vit. Rept. 1883–85, p. 124; 1885–86, p. 93.)

Synonyms: Enrageat; Plant de Dame; Grosse Chalosse; Grais; Rebauche in the southwest of France, and Piquepouille in the Department of Gers.

The Folle blanche is too well known at this time in its capacity of a brandy grape, and its wine as a blend for Bordeaux Clarets, to require more than a passing notice here. As a prolific bearer it has attracted considerable attention, but it should not be forgotten that the use of its wine for blending is practically limited by the amount of blendable red wines—that is, wines having sufficient character and color to stand the dilution of these qualities without the addition of something more definite than is supplied by the Folle blanche. The inverse ratio between quality and quantity cannot be too fully remembered, and unless the practice of reducing all wines to a common level, and paying so much per gallon of "wine" to the producer, be supposed to be perpetuated, the world's habit of paying mainly for high quality in wines must be conformed to. It seems predicable of the Folle blanche that it will yield a better quality of blending wine on valley land than either the Sultana or Burger, in the more northern regions of California.

Description.—Trunk short and thick; canes short, thick, of a reddish color, with internodes of medium length; leaves of medium size, five-lobed, petiolar sinus very slightly open, lateral sinus deep and open, teeth short and obtuse, superior surface deep green, glabrous, slightly puckered, the red veins of the inferior surface slightly pubescent; bunch large, compact, cylindrical or conico-cylindrical; berries large, spherical, of a whitish-green, acquiring a golden hue on the side exposed to the sun, skin thick, resistant, juicy, and sweet. Ripens about the second period of Pulliat.

The Folle blanche is the variety *par excellence* of the Charentes or Cognac region of France, where it constitutes nine tenths of the vines grown there. Its wine is very acid, and has little value for direct consumption, being all made into brandy. It is valuable, however, as a blend with the highly colored wines of the "Midi," communicating to them a pleasing freshness and remarkable brilliancy. This is especially true with regard to the Jaquez or Lenoir. It is planted also in considerable quantities in the "Graves" region with the high class of grapes of this type for the production of inferior Sauternes. It adapts itself to all kinds of rich soils. It is subject to spring frosts, and rots easily in wet years.

Wherever the Folle blanche has been tried in California it has usually supported its European reputation as a heavy bearer. Its average for three years at Cupertino was 4.6 tons per acre; about Stockton it gives good crops, but at Tulare the yield has been small. It yields a must characterized in general by low sugar and high acid, and is useful as a blend with certain red grapes to reduce their harshness and to aid their fermentation. From Livermore it is reported as making a good wine, but, in general, it is found to yield only a neutral wine of little character, good for certain blends, and, as in France, particularly suited for the production of brandy. At Tulare it produces an agreeable wine, which matures quickly and must be used young, as it soon deteriorates.

TABLE OF PRODUCTION.

FOLLE BLANCHE.	Number of Vines.....	Total Weight of Grapes, in lbs.....	Average per Vine, in lbs.	Date of Picking........
1887—No. 762 (long-pruned). J. T. Doyle, Cupertino....	20	282	14.1	Oct. 20
No. 763 (short-pruned). J. T. Doyle, Cupertino....	20	40	2.0	Oct. 20
1888—No. 937 (short-pruned). J. T. Doyle, Cupertino....	20	295	14.7	Oct. 23
No. 938 (long-pruned). J. T. Doyle, Cupertino....	20	465	23.2	Oct. 23
1889—No. 1167 (short-pruned). J. T. Doyle, Cupertino..	19	300	15.2	Oct. 11
Row 82 (short-pruned). J. T. Doyle, Cupertino....	20	200	10.0	Oct. 23

ANALYSES OF MUSTS AND WINES.

FOLLE BLANCHE.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
						By Weight	By Volume				
1884—No. 258. Natoma Wine Company, Natoma		22.10	21.97	.66	.27	9.92	12.36	.59		1.66	.21
No. 259. J. L. Black, Livermore		18.00		.47		7.43	8.75	.57		1.80	.24
No. 259*a*. Fresno		20.70	20.17	.59	.23						
1886—No. 515. J. T. Doyle, Cupertino		20.00	19.96	.47	.39	6.55	8.23	.69		1.80	
No. 574 (condensed must). J. D. Cone, Sacramento		23.70	24.12	.48	.36						
1887—No. 762 (long-pruned). J. T. Doyle, Cupertino	Oct. 20	23.23	22.23	.71	.35	8.91	11.09	.61	.10	2.20	
No. 763 (short-pruned). J. T. Doyle, Cupertino	Oct. 20	25.14	24.64	.58	.37	10.54	13.00	.50		2.60	
1888—No. 937 (short-pruned). J. T. Doyle, Cupertino	Oct. 23	21.89	22.67	.51	.30	8.48	10.58	.54		2.05	
No. 938 (long-pruned). J. T. Doyle, Cupertino	Oct. 23	21.41	21.80	.68	.26						
1889—No. 1167. J. T. Doyle, Cupertino	Oct. 11	21.95	22.22	.54	.29	8.91	11.09	.44		1.95	
No. 1183. J. Gallegos, Mission San José	Oct. 15	22.60		.44							
1890—No. 1272. J. T. Doyle, Cupertino	Sept. 29	18.15		.76	.24	7.09	8.85	.53		2.44	
No. 1421. J. Gallegos, Mission San José	Oct. 29	26.10		.71							
1891—No. 1452. Tulare	Aug. 26	18.60		.61							
No. 1482. Fresno	Sept. 7	20.65	20.00	.46	.54	8.48	10.58	.38		2.34	
No. 1534. Paso Robles	Oct. 6	18.10		.70							
1892—No. 1672. Tulare	Sept. 16	23.80	23.13	.45	.45	9.20	11.45	.44		2.70	
No. 1752. Paso Robles	Oct. 11	19.85		.60							
1893—No. 1837. Amador station	Sept. 5	19.30		.92							
No. 1860. Amador station	Sept. 12	19.30		.90							
No. 1909. Tulare	Oct. 3	21.50	20.61	.68	.42	8.13	10.17	.59		2.10	
No. 1992. Mission San José	Oct. 19	21.50		.53							
No. 2020. Mission San José	Oct. 27	20.50	19.82	.80	.23	8.27	10.36	.77		2.20	
No. 2032. J. T. Doyle, Cupertino	Oct. 31	23.05		.77							
1894—No. 2244. Mission San José	Oct 5	20.00		.49							
No. 2297. Mission San José	Oct. 12	19.40		.71							
No. 2329. Tulare	Oct. 15	22.60		.45							

RECORD OF TREATMENT.

No. 762. *Folle blanche*, from J. T. Doyle, Cupertino. Received October 21, 1887, in very good condition. The grapes were from long-pruned vines, and showed very little coulure or dried berries. The berries were, on the average, of medium size, but very uneven. The must showed 23.23% of solid contents by spindle and 0.71% of acid. The temperature of the grapes at crushing was 73°, and the maximum reached was 81°, on the third day. The fermentation was over on the fifth day.

At three weeks the wine was drawn off the thick lees. At two months it was clear, with light aroma and full acid; it was sound, but thin. Four months later it was racked again, and pasteurized. At eight months it was bright, and developed a good aroma, and was agreeable, but of rather sharp acidity.

No. 763. *Folle blanche*, from J. T. Doyle, Cupertino. Received October 21, 1887, in good condition. The grapes were from short-pruned vines, and showed more coulure and dried berries than those from the long-pruned vines. The sound berries were, however, larger and sweeter. The must showed 25.14% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 73°, and the maximum reached was 80°, on the third day. In eight days the fermentation was over.

At two weeks the wine was drawn off the lees. At two months the wine was light and neutral, with some aroma and pleasant acid. At eight months it was almost bright, well developed, of good body, pleasing acid, and some bouquet.

Nos. 937 and 938. *Folle blanche*, from J. T. Doyle, Cupertino. Received October 24, 1888, in fair condition. The must showed 21.89% of solid contents by spindle and 0.51% of acid in No. 937, and 21.41% of solid contents by spindle and 0.68% of acid in No. 938. The temperature of the grapes at crushing was 71°, and the maximum reached was 85°, on the fourth day. In twelve days the fermentation was over.

At six weeks the wine was racked and taken to the cellar. A month later it was nearly clear and of fair quality, but the lees showed faint traces of unsound germs, so the wine was pasteurized. At six months it was racked again, and at ten months it was clear, well developed, and agreeable. Four months later it showed some improvement. At sixteen months the lees were examined, and no unsound germs found; the wine was bright, with good flavor and well-developed bouquet—altogether a good wine, and mature. A month later it was racked and a part put in bottle. At twenty-one months the wine was in good order, somewhat thin, but of good flavor and bouquet. At twenty-two months it was bottled. At two years and five months the wine first bottled was clear and had made no deposit; it showed good bouquet and flavor, but was not quite clean-tasting. That bottled later was cleaner-tasting, but had less flavor. Eighteen months later the second bottling was still the better.

No. 1167. *Folle blanche*, from J. T. Doyle, Cupertino. Received October 15, 1889, in bad condition, many of the grapes being moldy. The must showed 21.95% of solid contents by spindle and 0.54% of acid. The maximum temperature reached was 82°, and the fermentation was over on the sixth day. In two months the wine was clear, of very light color, faint but agreeable aroma, clean-tasting, of medium body and full acidity, and, in general, rather good. A month later it was bright and well developed, but neutral. The lees were sound, but at seven months they showed some bitter ferments, and, though the taste was unaffected, the wine was pasteurized for safety. A month after pasteurizing the wine was bright, of delicate bouquet, good flavor, full and pleasing acid, and advanced development. The lees, which were examined twice after this, remained sound. At fifteen months the wine was in good condition—smooth, pleasing, and mature. Two months later it was racked, and at twenty-two months bottled. At two years and five months the wine was bright, very smooth, and pleasing, with little character, but no positive defects. A year later it had retained its good qualities, and had made a very little deposit in the bottle.

No. 1183. *Folle blanche*, from Mission San José. A sample for must analysis was received October 16, 1889, in fair condition, and mature; soft, juicy grapes, with somewhat thick and tough skin and insipid taste. The must showed 22.6% of solid contents by spindle.

No. 1272. *Folle blanche*, from J. T. Doyle, Cupertino. Received October 2, 1890, in bad condition—much bruised and with many moldy and rotten bunches. The grapes, which were not mature, were carefully picked over and fermented. The must showed 18.15% of solid contents by spindle. The fermentation lasted a week, and reached a maximum temperature of 80° on the fourth day.

The wine was slow in clearing, but at two months was clear, light, highly acid, clean-tasting, but lacking in bouquet and flavor. At three months the wine was much improved, having acquired some bouquet. At five months the wine showed some unsound germs in the lees, and was therefore pasteurized. The wine was green, but continued improving until it was fifteen months old, when part of it was bottled; the rest was bottled five months later. Fourteen months after bottling the wine was bright, of fair quality, lacking in bouquet, but of good flavor. That bottled later was somewhat exhausted, and inferior to the others.

No. 1421. *Folle blanche*, from J. Gallegos, Mission San José. A sample, for must analysis only, arrived October 31, 1890. The must showed 26.1% of solid contents by spindle.

No. 1452. *Folle blanche*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition, but not mature. The must showed 18.6% of solid contents by spindle.

No. 1482. *Folle blanche*, from H. Eggers, Fresno. Received September 9, 1891, somewhat injured from loose packing and a little moldy, not quite mature. The must, which showed 20.65% of solid contents by spindle, fermented through in six days.

The wine was at first slow in clearing, green, and without bouquet, but well flavored, smooth, and agreeable. It was racked twice during the first three months, and three times afterward; it remained green-tasting, but improved, and at six months was a light, neutral, fairly agreeable wine. After that it deteriorated somewhat. At eighteen months it was bottled, and but for a somewhat disagreeable odor was a fair wine.

No. 1534. *Folle blanche*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition, but not quite mature. Bunches were medium-sized, very compact, with small berries. The must showed 18.10% of solid contents by spindle.

No. 1672. *Folle blanche*, from Tulare station. Received September 19, 1892; a little crushed, but fresh. The must showed 23.8% of solid contents by spindle; it fermented well, attaining the maximum temperature of 80° on the third day after crushing.

The wine was racked twice during the first three months, cleared well, and as a young wine was very promising. At seven months it was at its best, in good condition, smooth and of good body, but lacking in flavor and bouquet. At fourteen months it was bright and sound, but a little flat and lacking in "finesse."

No. 1752. *Folle blanche*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. Solid contents by spindle, 19.85%.

No. 1837. *Folle blanche*, from Amador station. A sample for must analysis was received September 8, 1893, in good condition. Bunches and berries medium-sized; grapes not mature. The must showed 19.3% of solid contents by spindle.

No. 1860. *Folle blanche*, from Amador station. Received September 15, 1893, in good condition. The same as No. 1837, showing about the same degree of maturity.

No. 1909. *Folle blanche*, from Tulare station. Received October 5, 1893, in good condition. Large, juicy berries, in medium-sized bunches, mature, but with little flavor. The must showed 21.5% of solid contents by spindle. The fermentation was prompt and thorough, attaining its maximum, with a temperature of 82°, on the third day, and finishing on the third day.

The wine cleared rapidly, and was racked twice during the first month. At three months it was bright, had a little bouquet, some flavor, and good acid. At six months it had not changed much, but was a fairly fresh-tasting wine, without much character.

No. 1992. *Folle blanche*, from Mission San José. A sample for must analysis was received October 19, 1893, in good condition. The grapes were medium-sized, fleshy, thin-skinned, and quite mature. The must showed 21.5% of solid contents by spindle.

No. 2020. *Folle blanche*, from Mission San José. Received October 27, 1893, in poor condition—crushed, and with some mold. The must showed 20.5% of solid contents by spindle. The fermentation was slow and cool, and three weeks after crushing the wine contained a little sugar.

At three months the wine was bright, dry, and clean-tasting, with little bouquet, but distinctive flavor and full acid. At six months it was a good, clean-tasting wine, but with rather high and crude acid.

No. 2032. *Folle blanche*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The berries were rather large, juicy, and thick-skinned, in medium-sized bunches; they were mature, and commencing to rot. The must showed 23.05% of solid contents by spindle.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SAUTERNE TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Semillon.								
106	Glen Ellen	1883					10.58	.38	1.52
339	Lower Lake	1885	22.89		.55	.32			
434	San José	1885					13.00	.51	1.80
251	Natoma	1884	18.83	18.89	.54	.28			
252	Natoma	1884	21.69	20.99	.42	.28	12.36	.45	1.93
502	Cupertino	1886	18.40	18.29	.57	.23	8.93	.69	
745	Cupertino. (Long-pruned)	1887	24.89	24.12	.50	.40	12.54	.52	2.80
750	Cupertino. (Long-pruned)	1887	24.04	22.23	.54	.43	11.36	.47	2.60
753	Cupertino. (Short-pruned)	1887	25.26	25.53	.44	.45	12.82	.66	2.10
899	Cupertino. (Short-pruned)	1888	23.54	24.34	.34	.41	11.45	.54	2.60
900	Cupertino. (Long-pruned)	1888	22.81	22.85	.34	.42	11.27	.44	2.35
1131	Cupertino	1889	24.10	24.64	.41	.27			
1329	Cupertino	1890	23.70		.57				
2030	Cupertino	1893	24.55		.60				
1015	Fresno	1889	26.90	26.99	.31	.60			
1216	Fresno	1890	25.90	24.10	.32	.35			
1556	Paso Robles	1891	26.90		.38				
1648	Paso Robles	1892	22.15		.51				
1739	Paso Robles	1892	25.50		.39				
1668	Tulare	1892	24.00	24.64	.36	.45	12.54	.59	3.30
1798	Tulare	1893	21.50	20.24	.50	.28	9.50	.50	
2155	Tulare	1894	25.20		.35				
1657	Amador station	1892	23.65		.48				
1818	Amador station	1893	20.90	19.89	.63	.28			
2158	Amador station	1894	26.90		.38				
	Average, Natoma		**20.26**	**19.94**	**.48**	**.28**	**12.36**	**.45**	**1.93**
	Average, Cupertino		**23.47**	**23.14**	**.36**	**.37**	**11.39**	**.55**	**2.07**
	Average, Fresno		**26.40**	**25.55**	**.31**	**.47**			
	Average, Paso Robles		**23.82**		**.40**				
	Average, Tulare		**23.56**	**22.44**	**.40**	**.26**	**11.02**	**.59**	**3.30**
	Average, Amador station		**22.52**	**19.89**	**.49**	**.28**			
	Sauvignon blanc.								
253	Natoma	1884	21.66	21.22	.62	.31	12.75	.55	2.18
254	Natoma	1884	22.20	20.99	.53	.29	12.36	.45	2.10
335	Lower Lake	1885	24.20		.59				
1032	Fresno	1889	23.76	23.61	.79	.60			
1464	Fresno	1891	23.50	22.95	.76	.46	11.00	.53	2.74
1134	Cupertino	1889	26.10	26.12	.58	.37			
1317	Cupertino	1890	25.00		.58	.20	15.20	.48	2.12
2325	Tulare	1894	24.50		.35				
	Average, Natoma		**21.93**	**21.15**	**.57**	**.30**	**12.55**	**.50**	**2.14**
	Average, Fresno		**23.63**	**23.28**	**.77**	**.53**	**11.00**	**.53**	**2.74**
	Average, Cupertino		**25.55**	**26.12**	**.58**	**.28**	**15.20**	**.48**	**2.12**
	Sauvignon vert.								
724	Livermore	1887	22.67	22.67	.30	.42	11.82	.47	2.60
1513	Calistoga	1891	24.25	21.38	.53	.35	13.09	.53	2.20
1514	Asti, Sonoma County	1891	22.70	21.38	.44	.30	11.45	.53	2.55
490	Cupertino	1886	18.70	18.71	.42	.26	8.85	.53	1.75
697	Cupertino. (Long-pruned)	1887	23.01	23.23	.39	.34	12.00	.75	2.20
708	Cupertino. (Short-pruned)	1887	25.67	26.00	.47	.54	13.45	.44	2.60
880	Cupertino. (Short-pruned)	1888	21.39	21.38	.28	.40	9.90	.45	2.33
881	Cupertino. (Long-pruned)	1888	21.55	22.23	.27	.24			
1130	Cupertino	1889	23.30	22.95	.38	.39	11.91	.40	2.40
1275	Cupertino	1890	19.30		.51	.24	10.25	.42	2.20
2091	Cupertino	1893	24.10		.61				
1018	Fresno	1889	24.50	25.19	.46	.66			
1095	Fresno	1889	21.50	21.38	.58	.48	11.00	.47	2.70
1220	Fresno	1890	23.70	23.61	.47	.45			

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SAUTERNE TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Sauvignon vert—Continued.								
1455	Fresno	1891	21.50	......	.68	......	11.09	.49	2.60
1433	Tulare	1891	20.85	......	.30	.61	......	......	......
1669	Tulare	1892	25.45	25.53	.37	.49	......	......	......
1847	Tulare	1893	23.70	21.80	.54	.51	11.45	.44	2.60
2287	Tulare	1894	26.90	25.19	.38	......	12.82	.41	2.30
1540	Paso Robles	1891	25.55	......	.22	......	......	......	......
1733	Paso Robles	1892	23.70	......	.35	......	......	......	......
1961	Paso Robles	1893	29.30	......	.32	......	......	......	......
2218	Paso Robles	1894	25.65	......	.30	......	......	......	......
1821	Amador station	1893	22.60	21.38	.59	.21	......	......	......
2157	Amador station	1894	26.90	......	.38	......	......	......	......
	Average, Cupertino	......	**22.12**	**22.41**	**.41**	**.34**	**11.04**	**.50**	**2.24**
	Average, Fresno	......	**22.55**	**23.39**	**.54**	**.53**	**11.04**	**.48**	**2.65**
	Average, Tulare	......	**24.22**	**24.57**	**.40**	**.53**	**12.13**	**.42**	**2.45**
	Average, Paso Robles	......	**26.05**	......	**.30**	......	......	......	......
	Average, Amador station	......	**24.75**	**21.38**	**.48**	**.21**	......	......	......
	Folle blanche.								
258	Natoma	1884	22.10	21.97	.66	.27	12.36	.59	1.66
259	Livermore	1884	18.00	......	.47	......	8.75	.57	1.80
259*a*	Fresno	1884	20.70	20.17	.59	.23	......	......	......
1482	Fresno	1891	20.65	20.00	.46	.54	10.58	.38	2.34
574	Sacramento (condensed must)	1886	23.70	24.12	.48	.36	......	......	......
515	Cupertino	1886	20.00	19.96	.47	.39	8.23	.69	1.80
762	Cupertino. (Long-pruned)	1887	23.23	22.23	.71	.35	11.09	.61	2.20
763	Cupertino. (Short-pruned)	1887	25.14	24.64	.58	.37	13.00	.50	2.60
937	Cupertino. (Short-pruned)	1888	21.89	22.67	.51	.30	10.58	.54	2.05
938	Cupertino. (Long-pruned)	1888	21.41	21.80	.68	.26			
1167	Cupertino	1889	21.95	22.22	.54	.29	11.09	.44	1.95
1272	Cupertino	1890	18.15	......	.76	.24	8.85	.53	2.44
2032	Cupertino	1893	23.05	......	.77	......	......	......	......
1183	Mission San José	1889	22.60	......	.44	......	......	......	......
1421	Mission San José	1890	26.10	......	.71	......	......	......	......
1992	Mission San José	1893	21.50	......	.53	......	......	......	......
2020	Mission San José	1893	20.50	19.82	.80	.23	10.36	.77	2.20
2244	Mission San José	1894	20.00	......	.49	......	......	......	......
2297	Mission San José	1894	19.40	......	.71	......	......	......	......
1837	Amador station	1893	19.30	......	.92	......	......	......	......
1860	Amador station	1893	19.30	......	.90	......	......	......	......
1452	Tulare	1891	18.60	......	.61	......	......	......	......
1672	Tulare	1892	23.80	23.13	.45	.45	11.45	.44	2.70
1909	Tulare	1893	21.50	20.61	.68	.42	10.17	.59	2.10
2329	Tulare	1894	22.60	......	.45	......	......	......	......
1534	Paso Robles	1891	18.10	......	.70	......	......	......	......
1752	Paso Robles	......	19.85	......	.60	......	......	......	......
	Average, Fresno	......	**20.65**	**20.08**	**.52**	**.38**	**10.58**	**.38**	**2.34**
	Average, Cupertino	......	**21.85**	**22.25**	**.62**	**.31**	**10.47**	**.55**	**2.17**
	Average, Mission San Jose	......	**21.68**	**19.82**	**.61**	**.23**	**10.36**	**.77**	**2.20**
	Average, Amador station	......	**19.30**	......	**.91**	......	......	......	......
	Average, Tulare	......	**21.62**	**21.87**	**.54**	**.43**	**10.81**	**.51**	**2.40**
	Average, Paso Robles	......	**18.92**	......	**.65**	......	......	......	......

WHITE SOUTHERN FRENCH TYPE.

Properly speaking, there is no well-marked type of Southern French white wine. Few white wines are made in the "Midi," especially since the advent of the phylloxera, and of these only the dessert wines, sweet wines, and "vins de liqueur" have any extended reputation. The white grapes are generally used in small quantities with red grapes, to give smoothness and delicacy to the red wines. Few of the varieties of this group are promising for the production of white wines in California. From the Marsanne some good wines have been made, which can be used with advantage, where it succeeds well, as a blend with white grapes of more pronounced character. Some good wine has also been made from the Chauché gris, but the difficulty of handling the grapes and wine of this variety very much detract from its desirability. The Clairette blanche, which is shipped in such large quantities to Paris as a late table-grape, may find a like use here; it makes a high-class, delicately flavored wine. It is a very vigorous grower and a fairly heavy bearer, if its tendency to coulure can be overcome. This can, perhaps, be done by giving the vine a large development, instead of pruning it back to a close head.

CLAIRETTE BLANCHE.

(See Vit. Rept. 1883–85, p. 128; 1885–87, p. 96.)

Synonyms: Blanquette; Petit blanc.

Description.—Vine vigorous, with long, erect canes with rather short internodes; leaves of medium size, circular in outline, and with shallow sinuses, upper surface very dark green, cobwebby when young, becoming glabrous with age, lower surface thickly covered with a white down; bunches over medium in size, conical, heavily shouldered, close when not coulured; berries under medium in size, ovoid, white, crisp, juicy, and covered with bloom.

The Clairette blanche belongs altogether to southern France, within the region of olive culture; from below Valence, on the Rhone, to the Mediterranean coast, and along the same from Nice to the Spanish frontier. Within this region it has been extensively cultivated from ancient times to the present. It is used, not only to impart delicacy and spirit to red wines, but also by itself produces the wine commercially known as Picardan, as well as others locally designated as "Clairette." It is used for both dry and sweet wines. For the latter it is allowed to become overripe and shriveled on the vines. It is, besides, highly esteemed as a table-grape. It bears transportation well, and keeps well during the winter, being firm-fleshed; is crisp, sweet, and agreeably flavored.

The hardiness and vigorous growth of the Clairette are proverbial in southern France. No variety is longer-lived; it gives good crops even when old, and has resisted, longer than any other southern variety, the attacks of the phylloxera. It adapts itself readily to all soils, provided they are deep; on shallow, stony ground it is soon exhausted.

Some details regarding its growth and habit when grafted, as observed at Mission San José by Prof. Hilgard (Vit. Rept. 1885–86), are of sufficient interest to find a place here:

> The cuttings had become somewhat dry while waiting for favorable weather or for grafting, and considering this fact they showed a remarkable vitality. The grafts were made about two thirds on *Californica* stock, then in its third year from the planting of the seedling; the stocks ranged from three fourths to one and one fourth inches, and only one graft, as a rule, was put on each. The other third was put on *Riparia* and *Rupestris* stocks, varying, the first from one half to three fourths of an inch, the second rarely reaching one half inch; both being from the cutting, of the same age as the *Californica*.
>
> Of the grafts put on *Californica*, about 88% grew; of those on *Riparia*, about 50%; of those on *Rupestris*, about 20%. Only the *Californica* stock even remotely kept pace with the growth of the grafts themselves, which pushed with such vigor that it was very difficult to keep their branches from being wrenched off by the wind before being tied. This brittleness of the wood must be well kept in view in handling this vine, which needs strong stakes at least 30 inches high above ground, and somewhat elaborate tying-up, to prevent its being wrenched off by the overweight of the top, above any low-tied withe or rope. Of the *Rupestris* and *Riparia* grafts, few were thus injured, because of the flexibility of the thin stock; but, owing to the disproportion in the size of stock and scion, many of the grafts sent out vigorous roots and continued doing so after the removal of one set; showing clearly that these two stocks are (at least on the strong adobe of the Mission hills) quite inadequate to the demands of so vigorous a grower as the Clairette.
>
> All the grafts on *Californica* and many of those on *Riparia* bloomed profusely, and the majority set a fair proportion of berries, some bunches being almost without coulure; although, owing to the lateness of the bloom, the hot sunshine, and the violent winds, a great deal of coulure was naturally looked for, and in some cases made whole bunches fail entirely.

The Clairette is used in France for making wines of very diverse character; in the Department of Hérault it makes a good dry, white wine; in Var and Drôme it is used for the production of sparkling wines; in other localities a dry wine resembling Madeira is obtained from it; in others, a sweet wine with a strong "rancio" taste; while in many others it is used in small quantities as an addition to red wines.

It is best suited to a strong, clayey, well-drained soil, and is one of the best grapes to plant in a shady place. It is equally suited to either long or short pruning. Wherever planted in California it has proved itself a vigorous grower, with abundant and healthy foliage, and is resistant to diseases with the exception of coulure; though in France it is said to be peculiarly susceptible to the *Anthracnose ponctuée*. In the coast counties it has proved itself an unreliable bearer, sometimes giving good crops, but oftener badly damaged by coulure. In Tulare it has borne fairly well, and at the Foothill Station, in Amador County, it has been one of the best bearers among the white grapes. The average composition of the must has been: at Tulare, 24.3% of sugar and 0.35% of acid; at the Amador Station, 22.5% of sugar and 0.47% of acid; at Paso Robles, 23.5% of sugar and 0.39% of acid; at Mission San José, 22.0% of sugar and 0.55% of acid; at Cupertino, 20.6% of sugar and 0.46% of acid. In general, the wine has been of good quality, but not a good keeper. The best results, so far, have been from Tulare, where it makes a wine of rather more character and freshness than most of the other white grapes tried there; it also seems promising for Amador County. It ripens at the end of September in Amador County and the middle of October in Tulare; it resists the weather well, and can hang for a long time on the vines without damage.

ANALYSES OF MUSTS AND WINES.

CLAIRETTE BLANCHE.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
1884—No. 264. Natoma Wine Co., Natoma		21.34	21.07	.45	.31	10.54	13.00	.43		1.85	.21
1886—No. 481. J. Gallegos, Mission San José		17.50	17.22	.53	.28	7.09	8.85	.55		2.10	
No. 510. E. W. Hilgard, Mission San José		20.00		.87							
No. 513. F. Pohndorff, Jr., Mission San José		19.30		.56		6.89	8.61	.47		1.58	
No. 535. E. W. Hilgard, Mission San José		21.50	20.76	.86	.36	7.99	10.00	.51		1.80	
No. 535*a*.* E. W. Hilgard, Mission San José		21.50	20.76	.86	.36	7.85	9.82	.57		1.92	
1887—No. 771. E. W. Hilgard, Mission San José	Oct. 21	25.45	25.20	.45	.35	9.92	12.36	.61	.14	2.20	
1888—No. 948. E. W. Hilgard, Mission San José	Oct. 26	23.32	22.22	.26	.28	9.05	11.27	.55		1.80	
1889—No. 1170. J. Gallegos, Mission San José	Oct. 15	22.40	22.67	.41	.35	9.27	11.55	.40		2.55	
No. 1196. J. T. Doyle, Cupertino	Oct. 24	18.15	17.17	.34	.45	6.95	8.70	.42		1.35	
1890—No. 1398. J. T. Doyle, Cupertino	Oct. 18	21.10		.53							
No. 1420. J. Gallegos, Mission San José	Oct. 28	26.30		.54	.21	10.81	13.27	.42		2.78	
1891—No. 1543. Paso Robles	Oct. 7	24.80		.45							
1892—No. 1658. Amador station	Sept. 16	22.70		.46							
No. 1701. Tulare	Sept. 27	22.40		.29							
No. 1748. Paso Robles	Oct. 11	22.20		.32							
1893—No. 1838. Amador station	Sept. 5	18.00		.71							
No. 1862. Amador station	Sept. 12	21.70		.56							
No. 1969. Tulare	Oct. 14	22.90	21.38	.38	.30	9.20	11.45	.53		2.20	
No. 2029. Cupertino	Oct. 31	22.40		.50							
No. 2065. Mission San José	Nov. 1	24.80		.54							
1894—No. 2192. Amador station	Sept. 23	24.15		.39							
No. 2225. Mission San José	Oct. 2	20.60	19.21	.62				.64			
No. 2339. Tulare	Oct. 17	25.00		.34							
No. 2345. Mission San José	Oct. 22	20.85		.39							

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* Fermented with skins.

RECORD OF TREATMENT.

No. 771. *Clairette blanche*, from E. W. Hilgard, Mission San José. Received October 24, 1887, in fair condition, but rather overripe. The bunches were imperfect, and showed much early coulure. The must showed 25.45% of solid contents by spindle and 0.45% of acid. The temperature of the grapes at crushing was 71°, and the maximum reached was 81°, on the third day. On the eighth day the wine was dry.

At two months the wine was not very well developed and was not of agreeable flavor. The lees showed some secondary ferments, so the wine was pasteurized. Two months later it was bright, and had developed some bouquet, but was not clean-tasting. It was racked for the third time. After this the wine did not change much; it remained bright, but did not develop any good qualities.

No. 948. *Clairette blanche*, from E. W. Hilgard, Mission San José. Received October 29, 1888, in fair condition; many bunches contained dried and half-dried berries. The must showed 23.32% of solid contents by spindle and 0.26% of acid. The temperature of the grapes at the maximum point of fermentation was 90°, and the wine was quite dry on the thirteenth day.

At one month the wine was racked and taken to the cellar. Two months later it was almost clear and of delicate flavor. At five months it was racked again, and the lees were sound. At ten months it showed good quality, but was not well developed. At thirteen months it was quite bright, but not quite clean-tasting. After this it deteriorated steadily, and at two years it was thrown away.

No. 1170. *Clairette blanche*, from E. W. Hilgard, Mission San José. Received October 16, 1889, in good condition, and completely mature. The must showed 22.4% of solid contents by spindle and 0.41% of acid. The temperature reached its maximum of 79° on the third day after crushing. On the fifth day the wine was dry, and was racked off the thick lees.

At two months the wine was clear, of very light color, of peculiar and hardly pleasant flavor, earthy taste, low acid, medium body, and full alcohol. The wine was racked and taken to the cellar. A month later it was much improved in flavor, and had developed a little bouquet. It was racked again in five months. The lees were sound when examined at three and seven months. At eight months the wine was not quite bright, had light but pleasant bouquet, agreeable flavor, still a slight earthy taste, but much improved since January, smoother and more developed. After this the wine gradually deteriorated, and, although it was pasteurized at seventeen months, it was found impossible to keep it longer.

No. 1196. *Clairette blanche*, from J. T. Doyle, Cupertino. Received October 24, 1889, in bad condition. The grapes were crushed, and moldy on account of the rain; they were quite mature, though the must showed only 18.15% of solid contents by spindle and 0.34% of acid. The fermentation reached its maximum on the fourth day at a temperature of 73.5°, and the wine went on fermenting slowly for several days after.

At two weeks the wine was racked. At two months it was clear, but only of fair quality. At this date it was racked again and taken to the cellar. The wine was weak and thin, and a month later it began to show signs of spoiling. It was pasteurized, but its keeping qualities were so bad that it could not be preserved.

No. 1398. *Clairette blanche*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 21, 1890, in fair condition, and mature. The must showed 21.1% of solid contents by spindle.

No. 1420. *Clairette blanche*, from Mission San José. Received October 31, 1890, in fair condition—a few of the grapes moldy and a few dried, mature. The must showed 26.3% of solid contents by spindle. It attained its maximum temperature of 81°, on the fourth day, and on the seventh day was nearly dry.

The wine was racked once during the first five weeks, at the end of which time it was bright, very slightly sweet, with some aroma, a pleasant flavor, low acid, high alcohol, and, in general, of good quality. At three months it was bright, had good bouquet and full characteristic flavor, and was generally improved. At five months it was pasteurized, as it had deteriorated and the lees showed a few lactic filaments. At fourteen months it was bright, possessed a little bouquet and full flavor, and was, in general, a good wine, though somewhat exhausted. At sixteen months it was bottled. At two years after bottling it was an extremely smooth, soft wine and well kept, considering the smallness of the sample made.

No. 1543. *Clairette blanche*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition, mature; bunches of good size, well filled, but not compact. The must showed 24.8% of solid contents by spindle.

No. 1658. *Clairette blanche*, from Amador station. A sample for must analysis arrived September 19, 1892, in fair condition. The must showed 22.7% of solid contents by spindle.

No. 1701. *Clairette blanche*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 22.4% of solid contents by spindle.

No. 1748. *Clairette blanche*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 22.2% of solid contents by spindle.

No. 1838. *Clairette blanche*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition; both bunches and berries were very small, grapes flavorless and not mature. The must showed 18.0% of solid contents by spindle.

No. 1862. *Clairette blanche*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition; good-sized bunches of medium-sized berries, not quite mature. The must showed 21.7% of solid contents by spindle.

No. 1969. *Clairette blanche*, from Tulare station. Received October 16, 1893, in good condition. The bunches were under medium in size, loose, and irregular; berries varying from small to medium, crisp, and sweet. The must showed 22.9% of solid contents by spindle. The maximum temperature attained was 77°, on the third day, and in six days the must was nearly dry.

A month after crushing the wine had been racked once, and was clear and clean-tasting. At three months it was bright, with a little bouquet, some flavor, and full body; in general, a fair wine. At six months it had been racked three times, was bright and sound, with agreeable acid, and was fresher-tasting than most of the Tulare wines.

No. 2029. *Clairette blanche*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, conical, with small wings, loose, but with no coulure; berries of medium size, crisp, juicy, and sweet. The must showed 22.4% of solid contents by spindle.

No. 2065. *Clairette blanche*, from Mission San José. A sample for must analysis was received November 1, 1893, in good condition. The bunches were large, loose, conical, with large wings, some coulure; berries small and pulpy. The must showed 24.8% of solid contents by spindle.

MARSANNE.

(See Vit. Rept. 1883-85, p. 127; 1885-87, p. 96.)

Description.—Vine vigorous; canes strong, with elongated internodes; leaves large, wrinkled, with rather deep lateral and closed petiolar sinuses, teeth short, wide, obtuse, upper surface glabrous, lower sparsely covered with an arachnoid down; bunch rather large, winged, and rather compact; berries of medium size, round, whitish, crisp, and juicy.

In general, the bunches are more compact in California than in France, and in Tulare the grapes acquire the hard, fleshy character distinguishing many of the Sherry varieties. At most of the stations this variety has shown itself a strong grower, with abundant foliage, and a good bearer, even with short-pruning. In Tulare it has done well, except where the alkali is too strong, bearing between four and five tons per acre. In the coast counties it bears from two to five tons per acre. It seems more susceptible to *oidium* in California than in France, and at the Amador station it has suffered from sunburn. At the latter station the vine grows well in red soil, but on a cool, granite soil it has not done so well, producing bunches of small and abortive berries.

It has given satisfaction in parts of Napa, Santa Clara, and San Mateo, but at the stations the grapes have generally been too high in sugar and too low in acid for a good and easily handled dry wine. At Tulare it gives a good, sweet wine of Sherry type, but is a failure for dry wine, having too much body and too little acid. Though not especially to be recommended for use alone, it is an excellent blend for varieties which lack alcoholic strength and body. Professor Husmann finds that it greatly improves either Sauvignon vert or Green Hungarian.

ANALYSES OF MUSTS AND WINES.

MARSANNE.		Date of Picking	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body	Sugar
1890—No. 1412.	Cupertino	Oct. 29	24.10	------	.66	.27	10.35	12.82	.50	2.50	----
1892—No. 1619.	Tulare	Aug. 28	25.65	23.67	.38	.45	18.05*	22.18	.43	3.66	.94
1893—No. 1856.	Amador station	Sept. 12	23.70	------	.48	----	------	------	------	------	----
No. 1960.	Paso Robles	Oct. 12	24.10	------	.24	----	------	------	------	------	----
No. 2000.	Tulare	Oct. 22	26.10	25.76	.41	.50	10.27	12.73	.43	2.90	----
No. 2097.	Cupertino	Nov. 6	25.90	------	.63	----	------	------	------	------	----
1894—No. 2162.	Amador station	Sept. 15	26.70	------	.34	----	------	------	------	------	----
No. 2203.	Tulare	Sept. 25	27.35	------	.26	----	------	------	------	------	----

* Fortified.

RECORD OF TREATMENT.

No. 1412. *Marsanne*, from J. T. Doyle, Cupertino. Received October 30, 1890, in fair condition. The grapes had passed maturity, but were not very sweet; some had commenced to rot, all more or less shriveled, but tasting well. The must showed 24.1% of solid contents by spindle. The fermentation reached its maximum on the fourth day, at a temperature of 79°, and continued for seven days, when the wine was nearly dry.

At five weeks the wine had been racked twice, and was clear, of delicate bouquet and flavor, smooth, with medium acid, and generally good. At three months it was bright, of marked and agreeable flavor and good bouquet, and generally improved. Successive tastings during the first year showed a gradual improvement, and at fourteen months the wine was bright, clean-tasting, and of high quality. The wine was bottled, some at sixteen months and some at twenty-four months. The latter bottling did not keep well, but the former at ten months after bottling was bright, smooth, and good, but a little flat.

No. 1619. *Marsanne*, from Tulare station. Received September 1, 1893, in good condition. The must showed 25.65% of solid contents by spindle. The must, having high sugar contents, low acid, and showing signs of not fermenting well, was made into a sweet wine. The fermentation reached its maximum on the third day, at a temperature of 78°, and on the sixth day, while the must was still sweet, it was fortified.

The wine was clear three weeks after crushing, and was racked. At three months it was bright, clean-tasting, with low acid, but with hardly sufficient sweetness. At six months more alcohol and a little sugar were added, and the wine put into a hot chamber at a temperature of 95°, where it remained for three months. At ten months it was bright, of good flavor, and promised to make a good Sherry.

No. 1856. *Marsanne*, from Amador station. A sample for must analysis arrived September 15, 1893, in poor condition, and diseased. Bunches were of medium size, compact; berries small to medium, well colored. The must showed 23.7% of solid contents by spindle.

No. 1960. *Marsanne*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in good condition. Bunches were large, irregular, and loose; berries medium size, round, very hard, and fleshy, not quite mature. The must showed 24.1% of solid contents by spindle.

No. 2000. *Marsanne*, from Tulare station. Received October 23, 1893, in good condition. Bunches were of medium size, short, irregularly cylindrical, sometimes shouldered, close; berries of medium size, with many smaller ones, round, thin-skinned, of pleasant flavor, quite mature, some berries softening and drying up. The must showed 26.1% of solid contents by spindle. The must was dry in five days, the fermentation reaching its height on the third day at a temperature of 83°.

The wine was clear one month after crushing, and was racked twice during the first six weeks. At three months, three weeks after the third racking, it was bright, heavy-bodied, with some flavor and bouquet, but lacking in cleanness of taste and freshness. At six months it was bright and apparently sound, but the odor was not good and the taste slightly bitter.

No. 2097. *Marsanne*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. Bunches were of medium size, irregular, winged or branched, well filled, but with many abortive berries; normal berries, of medium size, round, soft. The must showed 25.9% of solid contents by spindle.

CHASSELAS DORÉ.

(See Vit. Rept. 1885–86, p. 100.)

Synonyms: Chasselas de Fontainebleau; Gutedel; Sweetwater.

There are planted in California many of the innumerable varieties of Chasselas which are known in Europe, but the one which is best known and most extensively planted is the true Chasselas doré of France. All the members of the Chasselas tribe are distinguished by the brownish color of the young shoots and leaves, the round shape of the berries, and the peculiar texture of the skin and the flesh. The description here given is that of the typical Chasselas doré.

Description.—A rather vigorous grower, with medium or somewhat slender canes of a reddish-brown color; young shoots of garnet color, nearly or quite glabrous; leaves rather below average size, a little longer than wide, glabrous above and nearly so below, except for a few hairs on the main nerves, with well-marked sinuses, the petiolar one often closed, the petiole long, rather slender, and rose-colored; bunches of medium or over-medium size, conico-cylindrical, shouldered, more or less compact; berries medium to large, with firm but tender skin, small seeds, of delicate flavor and texture, at first crisp but becoming soft with full maturity. The grapes are of a clear green color, tinged with a beautiful golden bronze where exposed to the sun.

This variety should not be confused with the Listan or Palomino, which goes under the name of Golden Chasselas in Napa County and other localities. The latter is a totally different grape, belongs to the Sherry type, and is in no sense a Chasselas of any kind.

As a table-grape the Chasselas has failed to satisfy the public taste here as it does in France, except to a limited extent as one of the earliest grapes that can be put on the market. It is too delicate to be used for any but the local markets, as it will not bear shipping very well, and notwithstanding its admirable flavor and texture it is not striking enough in appearance to meet the demands of our markets. In France the Chasselas is not generally much valued as a wine-grape; though the Gutedel wines of Germany and Switzerland are light, pleasant, and much esteemed. On the whole, this variety has given more satisfaction in California as a wine-grape than as a table-grape.

As a wine-grape its value depends altogether on the conditions under which it is grown. In the coast counties it is healthy, fairly vigorous, and productive; in the interior valleys it is a failure. On warm, well-drained southern or western slopes in the central coast counties it produces an excellent wine, clean-tasting, full-bodied, without much distinctive flavor or aroma, but developing a good bouquet with age, and keeping well. In these situations it has the advantage, especially desirable for white wines, of attaining perfect maturity, and even passing it without becoming too high in sugar or falling so low in acid as to make it difficult to ferment. Grapes from low or cold soils often ferment badly and easily go wrong. The average must composition has been: at Cupertino, 21.9% of sugar and 0.35% of acid; at Mission San José, 22.2% of sugar and 0.37% of acid; at Tulare, 22.3% of sugar and 0.23% of acid. At Cupertino the average crop has been four tons per acre; at Tulare, less than two tons. In none of these localities are the results as good as those obtained with this grape on warm slopes of Napa, Sonoma, and Santa Clara, where the conditions insure a more favorable must composition than is indicated by the above averages.

The Chasselas is almost always pruned short, though occasionally in rich soils it has been found advantageous to prune it long, but only when the grapes are to be used for eating. It is of great importance to choose fertile canes in the propagation of this variety, in order to insure good-bearing vines. The vines are somewhat subject to attacks of fungous diseases, and succumb quickly to the phylloxera. There is a variety of the Chasselas doré known as the Parsley vine, in French "Cioutat," having deeply cut or lacinate leaves, but which, with the exception of the leaves, is identical with the type.

TABLE OF PRODUCTION.

CHASSELAS DORÉ.	Number of Vines......	Total Weight of Grapes, in lbs......	Average per Vine, in lbs..	Date of Picking........
1887—No. 696 (long-pruned). J. T. Doyle, Cupertino....	20	210	10.5	Oct. 5
1888—No. 917 (short-pruned). J. T. Doyle, Cupertino...	20	130	6.5	Oct. 18
No. 918 (long-pruned). J. T. Doyle, Cupertino....	20	320	16.0	Oct. 18
1889—Row 25 (short-pruned). J. T. Doyle, Cupertino...	20	250	12.5	Oct. 9

ANALYSES OF MUSTS AND WINES.

CHASSELAS DORÉ.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body
1886—No. 476. J. T. Doyle, Cupertino	Sept. 15	17.50	......	.40	.25	6.89	8.61	.41	......
1887—No. 696. J. T. Doyle, Cupertino	Oct. 5	23.17	23.61	.31	.33	9.34	11.64	.53	1.87
1888—No. 917 (short-pruned). J. T. Doyle, Cupertino	Oct. 18	22.89	24.12	.20	.50	9.20	11.45	.38	2.25
No. 918 (long-pruned). J. T. Doyle, Cupertino	Oct. 18	22.24	22.67	.22	.33				
1889—No. 1112. J. Gallegos, Mission San José	Sept. 28	22.60	21.80	.25	.38	9.20	11.45	.28	2.28
1890—No. 1260. J. Gallegos, Mission San José	Sept. 23	21.93	......	.40	.26	......	......	......	......
No. 1267. J. T. Doyle, Cupertino	Sept. 29	22.30	......	.44	.29	......	......	......	......
1891—No. 1448. Tulare	Aug. 26	24.53	......	.18	......	......	......	......	......
No. 1561. Mission San José	Oct. 6	22.15	......	.40	......	9.20	11.45	.39	1.80
1892—No. 1677. Tulare	Sept. 18	20.20	......	.29	......	7.92	9.90	.40	2.70
No. 1776. Mission San José	Oct. 13	20.85	21.38	.37	......	8.84	11.00	.53	2.10
1893—No. 1948. Mission San José	Oct. 14	23.70	......	.46	......	......	......	......	......
No. 2086. J. T. Doyle, Cupertino	Nov. 6	23.10	......	.53	......	......	......	......	......
1894—No. 2247. Mission San José	Oct. 3	21.90	......	.35	......	......	......	......	......
No. 2324. Tulare	Oct. 13	22.15	......	.21	......	......	......	......	......

RECORD OF TREATMENT.

No. 696. *Chasselas doré*, from J. T. Doyle, Cupertino. Received October 6, 1887, in good condition, but overripe. The bunches showed a little coulure, and varied from loose to compact; the berries were uneven in size. The must showed 23.17% of solid contents by spindle and 0.31% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 85°, on the second day. The fermenting must was thoroughly aërated for twenty minutes on the first, second, third, and fourth days. The wine was quite dry on the eighth day.

At two weeks the wine was racked and taken to the cellar. At two months it was a thin wine, and the acid was evidently increasing, so it was racked again and pasteurized. Five days after pasteurizing it was still a little cloudy, had pleasant flavor and aroma, but was thin and too acid. At eight months it was nearly bright, and was a pleasant wine, with some bouquet, but showed the effect of secondary fermentation.

Nos. 917 and 918. *Chasselas doré*, from J. T. Doyle, Cupertino. Received October 19, 1888, in good condition. No. 917, which was from short pruned vines, showed less coulure than No. 918, from long-pruned vines. The composition of the must of No. 917 was 22.89% of solid contents by spindle and 0.20% of acid; that of No. 918, 22.24% of solid contents by spindle and 0.22% of acid. The grapes of both lots, which were quite mature, were crushed together. The temperature of the must at the maximum was 85°. The wine fermented slowly, and was dry in fifteen days.

At three weeks the wine was racked and placed in the cellar. At seven weeks it was racked again. At three months it tasted thin and characterless. Two months later it was necessary to pasteurize it, as it showed signs of going wrong. Three months later it was racked, and at ten months it showed some good qualities, but was not quite bright. At fourteen months some wine bottled at eight months tasted quite as good as the wine in the keg. At sixteen months the wine, both in the keg and in the demijohn, was clean-tasting, but not of high quality; it was racked again. At seventeen months more of the wine was bottled. At eighteen months it was given a half-hour treatment in an electric machine. At twenty-one months it was bright, and of fair quality; the flavor was rather agreeable, but the bouquet and after-taste were not pleasing. A month later the rest of the wine was bottled. At two years and four months the wine bottled at eight months was bright, of neutral flavor, without bouquet, and with suspicion of bad acid. That bottled at seventeen months was bright and of more agreeable flavor than the above; there was a slight deposit in the bottles. That bottled at twenty-two months was similar to the second bottling, but had made no deposit. Nineteen months later the first and second bottlings were not nearly so good as the last, which had been treated by electricity.

No. 1112. *Chasselas doré*, from J. Gallegos, Mission San José. Received October 1, 1889, in good condition. The bunches were large and close; the berries large. The must showed 22.6% of solid contents by spindle and 0.25% of acid. The must was fermented in a closed keg surrounded by a jacket of water kept at a temperature of 65.5°. The wine was drawn off the thick lees on the eighteenth day.

At two months, when it was racked and taken to the cellar, it was clear and good, but somewhat thin. Two months later it was bright and smooth, somewhat characterless, and undeveloped. At five months the lees showed unsound ferments, and the wine was pasteurized. Six weeks later it was clear and sound. At nine months it was bright, smooth and agreeable, but with little character. A month later an examination of the lees showed no unsound germs; the wine was racked, and was clear and improved, but lacking in acid. At fifteen months it was bright and sound, but tasted thin. Six weeks later it was bottled. A year after bottling it was in good condition and had made a little deposit; it was smooth and fairly pleasing, but somewhat exhausted.

No. 1260. *Chasselas doré*, from Mission San José. A sample for must analysis was received September 26, 1890, in good condition. Bunches and grapes were large, the latter mature. The must showed 21.93% of solid contents by spindle.

No. 1267. *Chasselas doré*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 2, 1893, in good condition, and mature. The berries were, in general, large, but mixed with many small ones. The must showed 22.3% of solid contents by spindle.

No. 1448. *Chasselas doré*, from Tulare station. A sample for must analysis arrived August 29, 1891, in good condition. The must showed 24.53% of solid contents by spindle.

No. 1561. *Chasselas doré*, from Mission San José. Received October 9, 1893, in good condition; mature and not shriveled, but turning pink. The must showed 22.15% of solid contents by spindle. The must reached its highest temperature on the fourth day at 82°, and was dry on the seventh day.

At six weeks from crushing the wine was nearly clear, and of good flavor. At five months it had been racked twice, was bright, with some bouquet, and good though not marked flavor, very soft and pleasing, maturing slowly. During the first year it was racked four times, and at seventeen months it was bottled, when it showed little improvement and lack of body.

No. 1677. *Chasselas doré*, from Tulare station. Received September 21, 1892, in good condition, but rather soft. The must showed 20.2% of solid contents by spindle. The fermentation was cool, and lasted six days.

At five weeks the wine was quite dry and clear, and was racked for the second time. At four months it was bright, with a light but pleasing bouquet and flavor—a very smooth, neutral wine. It continued to improve for seven or eight months, after which it deteriorated, and though it remained bright and sound, it became mawkish and insipid.

No. 1776. *Chasselas doré*, from Mission San José. Received October 15, 1892, in good condition. The must showed 20.85% of solid contents by spindle. The must was fermented with 23% of Johannisberger, and went through in six days, attaining a maximum temperature of 82° on the fourth day.

The wine was clear in three weeks, and was racked twice during the first month. At three months it was an excellent wine, with rich flavor, aroma, and good body. At eight months it was in first-class order, of good quality, and almost mature. At eighteen months the wine was mature, and was bottled.

No. 1948. *Chasselas doré*, from Mission San José. A sample for must analysis was received October 14, 1893, in poor condition—very moldy, but fine grapes and fully ripe. The must showed 23.7% of solid contents by spindle.

No. 2086. *Chasselas doré*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. Bunches were of medium size, well filled; berries overripe and soft, but with no raisin taste. The must showed 23.1% of solid contents by spindle.

UGNI BLANC.

(See Vit. Rept. 1883-85, p. 137.)

Synonyms: Macçabeo; Queue de Renard; Clairette à grains ronds.

Description.—Vine vigorous, with long, reddish-gray canes of average thickness and long internodes; leaves of medium size, with upper sinuses deep and often closed, lower sinuses shallower and open, teeth large and acute, upper surface yellowish, downy when young, lower surface whitish, with a thick down; bunch long, cylindrical, with or without small shoulders, well filled; berries of medium size, round, white, becoming russet on one side when well ripened, soft, juicy, with tough but easily broken skin.

The Ugni blanc is very late, and only ripens well in the hottest regions of Provence. It is not exacting as to the nature of the soil in which it grows, providing it is not too wet. It buds out late in spring, thus escaping the late frosts. It gives, especially when grown on rocky hills, a generous wine, which, with age, acquires something of the character of Marsala. It is to this grape that the white wines of Cassis, in Bouches du Rhone, owe their quality.

So far, it has not shown qualities in California that would recommend it for cultivation in any locality. Its average yield has been two tons per acre at Cupertino and three tons at Tulare. Contrary to the reputation it has in France, it is here very easily injured by the weather and is not a particularly robust grower. It produces a light, acid wine, which is of fair quality, matures quickly, and is useful for blending. It is, however, little, if at all, better for this purpose than several others which are of superior productiveness. The average composition of the must at Mission San José and at Cupertino has been 20.9% of sugar and 0.76% of acid; at Tulare, 22.8% of sugar and 0.40% of acid.

TABLE OF PRODUCTION.

UGNI BLANC.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 785 (long-pruned). J. T. Doyle, Cupertino	20	116	5.8	Oct. 27
1888—No. 954 (long-pruned). J. T. Doyle, Cupertino	18	110	6.1	Nov. 6
1889—No. 1195 (short-pruned). J. T. Doyle, Cupertino	19	140	7.3	Oct. 23

Analyses of Musts and Wines.

UGNI BLANC.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at 6 to 8 Months	Volatile Acid	Body	Ash
1884—No. 274. Natoma Wine Company, Natoma	......	20.70	20.61	.59	.49	8.91	11.10	.51	......	2.00	.30
1887—No. 785. J. T. Doyle, Cupertino	Oct. 27	21.46	20.99	.87	.47	7.71	9.63	.56	.15	2.60	......
1888—No. 954. J. T. Doyle, Cupertino	Nov. 6	19.75	20.03	.50	.37	7.78	9.73	.45	......	2.30	......
1889—No. 1195. J. T. Doyle, Cupertino	Oct. 23	22.80	21.80	.51	.29	9.20	11.45	.39	......	2.00	......
1890—No. 1405. J. T. Doyle, Cupertino	Oct. 20	23.05	......	.91	.34	9.05	11.27	.74	......	1.54	......
1892—No. 1704. Tulare	Sept. 27	22.15	......	.45	......	......	......	......	......	......	......
No. 1737. Paso Robles	Oct. 10	24.20	......	.51	......	......	......	......	......	......	......
1893—No. 2026. J. T. Doyle, Cupertino	Oct. 31	22.40	......	1.00	......	......	......	......	......	......	......
1894—No. 2352. Tulare	Oct. 27	23.30	......	.36	......	......	......	......	......	......	......

RECORD OF TREATMENT.

No. 785. *Ugni blanc*, from J. T. Doyle, Cupertino. Received October 28, 1887, in good condition. The bunches were loosely pendent, and showed little coulure; the berries were very thin-skinned and juicy, perfectly round, and with little bloom; a few were shriveled and dried. The must showed 21.46% of solid contents by spindle, and 0.87% of acid. The temperature of the grapes at crushing was 74°, and the maximum reached was 84°, on the second day. The wine was dry on the fourth day.

At two weeks the wine was drawn off for the first time. At two months it showed little aroma and sharp acid. At four months the lees showed some acetic ferment, and the wine was drawn off and pasteurized. At seven months it was still cloudy, tasted green, and was highly acid; it had developed some bouquet, but was, on the whole, rather thin and poor. At eight months it was bright, but later it deteriorated.

No. 954. · *Ugni blanc*, from J. T. Doyle, Cupertino. Received November 7, 1888, in good condition, and crushed the following day. The must showed 19.75% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 63°, and the maximum reached was 81°, on the fourth day.

At two weeks the wine was drawn off the thick lees, and at one month it was taken to the cellar. At two months it was a thin, acid wine, with little aroma and low alcohol At four months it was racked again, and the lees found to be healthy. At ten months it was clear, and had improved. At thirteen months the wine which had been put in bottle at four months was better than the wine in the keg, both in flavor and cleanness of taste. At fifteen months it was clear, mature, neutral, but fairly agreeable. A month later it was racked. At this time it was at its best, and later it deteriorated.

No. 1195. *Ugni blanc*, from J. T. Doyle, Cupertino. Received October 24, 1889, in bad condition—injured by rain, but quite mature. The bunches were very unequal in size, the larger ones very large, long, cylindrical, shouldered, and compact; the berries were round and of medium size, with thin but tough skin, varying from green to pinkish; flesh very soft and juicy; stems of medium size, pedicels long and slender. The must showed 22.8% of solid contents by spindle and 0.51% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 76.5°, on the third day. The wine continued fermenting slowly for a long time.

At two weeks the wine was drawn off the thick lees. At six weeks it was clear, very light in color, smooth, with faint aroma and agreeable flavor, with sufficient body and alcohol, and, in general, rather pleasing. At two months it was racked and taken to the cellar, and at three months it was bright and had improved. At six months it was racked again, and at seven months the lees were examined and found to be healthy. At eight months the wine was bright, had developed some bouquet, and was, in general, a smooth, light, and pleasing wine, nearly mature. After this it deteriorated.

No. 1405. *Ugni blanc*, from J. T. Doyle, Cupertino. Received October 23, 1890, in fair condition, and mature. The must showed 23.05% of solid contents by spindle. The fermentation reached its maximum on the third day at a temperature of 82°, and lasted eight days.

A month from crushing the wine was nearly clear, had full flavor and acid, light body, and clean taste. At two months from crushing it was racked, and at three months was bright, and showed some improvement and the development of some bouquet. At five months the lees showed a few filaments, but the taste was unaffected; it was pasteurized for safety. It remained bright, and at fourteen months was mature, had a good flavor, a little bouquet, high but somewhat green acid, and in general was of fair quality. At fifteen months it was bottled. At two years it showed good qualities, but was somewhat exhausted.

No. 1704. *Ugni blanc*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition, but very small, having been grown on alkali soil. The must showed 22.15% of solid contents by spindle.

No. 1737. *Ugni blanc*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 24.2% of solid contents by spindle.

No. 2026. *Ugni blanc*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The bunches were over medium in size, long-cylindrical, scarcely shouldered, and close; the berries of medium size, very juicy, and thick-skinned, with high acid, and not quite mature. The must showed 22.4% of solid contents by spindle.

VERDAL.

(See Vit. Rept., 1885-86, p. 104.)

Synonyms: Aspiran blanc; Servan blanc (?).

This grape has found quite extended acceptance for table use, and to some extent for wine. It is a grape of southern France, particularly the Languedoc, and in its three varieties—the red, gray, and white—is quite extensively grown, for both table use and wine-making. The white variety, which is less prolific than the other two, is used for the table only, while the other two produce very popular table wines, of which the red, however, lacks sufficient color for commercial use, and neither it nor the white is exported. The wines possess a light aroma or perfume peculiar to this grape. The vine is pruned sometimes with one long spur, but mostly altogether short.

Description.—Vine of medium vigor and rather hardy; canes somewhat slender and half erect; leaves of average size, glabrous on both surfaces, except below near the axils of the main nerves, sinuses well marked and generally closed, giving the leaf the appearance of having five holes, in the manner of those of Cabernet Sauvignon; teeth long, unequal, and somewhat acuminate; bunches large to very large, irregularly long-conical, without any or with small shoulders, well-filled to compact; berries large to very large, crisp, with thick but tender skin, agreeable, but without marked flavor.

This variety has proved to be a good grower and prolific bearer almost wherever grown, is little subject to disease, and shades its grapes well. In the cooler localities it is occasionally injured by coulure and by the abortion of its berries. The vines are sometimes pruned long, but in places suited to the variety it will bear enough, or even too much, with short-pruning; long canes tend to exhaust the vine. The grapes have been successful for table use, on account of their lateness and their good keeping qualities; they will hang and remain sound on the vines later than almost any other variety. As a wine-grape, it is less recommendable, making in the Coast Range a thin wine of little character.

In the hot interior valleys it is at its best as a wine-grape. At Tulare, where it produces nearly fourteen tons per acre, it makes a light, agreeable wine, with little flavor or bouquet, but easily fermented and handled; a wine which, at six or eight months, is at its best, bright, and clean-tasting. It is too light to keep for a long time, but would make a good blend with heavy-bodied, alcoholic wines. For this purpose it is, however, not equal to the Burger, but has the advantage of being at the same time a good table-grape, and of resisting the weather better than the latter.

The average composition of the must at Tulare has been 18.4% of sugar and 0.57% of acid. This could probably be improved by preventing the vines from bearing so heavily. At Paso Robles the grape is promising, being vigorous and productive, and having an average must composition of 21.6% of sugar and 0.51% of acid, but has not yet been sufficiently tried for wine.

ANALYSES OF MUSTS AND WINES.

VERDAL.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
1885—No. 367.	D. C. Feely, Patchen	......	14.91	......	.53	.26	6.42	8.07	.52	......	1.80	.19
1886—No. 512.	R. Wegener, Livermore	......	21.80	21.07	.38	.30	8.27	10.36	.41	......	1.80	......
No. 585.	D. C. Feely, Patchen	......	17.00	15.11	.63	.47	6.75	8.46	.55	......	1.55	......
1887—No. 701.	R. Wegener, Livermore	Oct. 5	22.84	23.22	.52	.37	8.62	10.75	.43	.08	2.60	......
No. 803.	W. G. Klee, Glenwood	Nov. 29	20.65	20.10	.75	.40	......	......	......	......	......	......
1889—No. 1164.	J. T. Doyle, Cupertino	Oct. 12	21.50	......	.48	......	......	......	......	......	......	......
No. 1188.	J. Gallegos, Mission San José	Oct. 13	19.50	......	.57	......	......	......	......	......	......	......
1890—No. 1361.	J. T. Doyle, Cupertino	Oct. 14	18.95	......	.84	.23	7.78	9.73	.46	......	1.80	......
No. 1430.	J. Gallegos, Mission San José	Oct. 27	22.15	......	.63	......	......	......	......	......	......	......
1891—No. 1453.	Tulare	Aug. 27	18.82	18.30	.53	......	6.42	8.07	.40	......	2.60	......
1892—No. 1706.	Tulare	Oct. 4	20.40	19.75	.42	.43	8.84	11.00	.46	......	2.30	......
1893—No. 1912.	Tulare	Oct. 5	18.80	17.70	.75	.39	7.43	9.27	.48	......	2.60	......
No. 1964.	Paso Robles	Oct. 12	22.85	......	.52	......	......	......	......	......	......	......
No. 1982.	Tulare	Oct. 17	19.30	18.46	.58	.25	7.64	9.54	.45	......	2.60	......
No. 2082.	Paso Robles	Nov. 3	22.70	21.63	.51	.37	8.34	10.12	.51	......	2.25	......
1894—No. 2233.	Mission San José	Oct. 3	20.40	......	.53	......	......	......	......	......	......	......
No. 2342.	Tulare	Oct. 20	19.30	17.99	.59	......	......	......	......	......	......	......

RECORD OF TREATMENT.

No. 701. *Verdal*, from R. Wegener, Livermore. Received October 7, 1887, in good condition. The bunches were large, loose, and showed a little coulure; the berries were large, and well covered with bloom. The must showed 22.84% of solid contents by spindle and 0.52% of acid. The temperature of the grapes at crushing was 65.5°, and the maximum reached was 89°, on the third day. The wine was drawn off on the eleventh day.

At two months it was clear, with good aroma, light and pleasant acid, but was rather thin. A month later it was racked again. At sixth months the lees showed traces of unsound ferments, so the wine was racked and pasteurized. At eight months it was bright, with little bouquet—a fair, neutral wine.

No. 803. *Verdal*, from W. G. Klee, Santa Cruz Mountains. A sample for must analysis was received November 30, 1887, in fair condition, some of the bunches showing traces of mold. The bunches were very large and loose, on account of coulure. The berries were very large, and with much less bloom than the sample from Livermore; however, they were larger than those of the latter sample, and of more agreeable flavor. The must showed 20.65% of solid contents by spindle and 0.75% of acid.

No. 1164. *Verdal*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 15, 1889, in good condition. The bunches were large to medium, pyramidal, winged, loose; the berries very large, ellipsoidal, with thick but tender skin, of green to yellowish-green color, well covered with bloom; the flesh crisp and juicy, sweet, and agreeable; the stems slender and green; the pedicels short and thick. The must showed 21.5% of solid contents by spindle and 0.48% of acid.

No. 1188. *Verdal*, from J. Gallegos, Mission San José. A sample for must analysis was received October 16, 1889, in good condition. The grapes were rather larger than those from Cupertino, but were otherwise identical. The must showed 19.5% of solid contents by spindle and 0.57% of acid.

No. 1361. *Verdal*, from J. T. Doyle, Cupertino. Received October 17, 1890, in good condition, but not mature. The must showed 18.95% of solid contents by spindle. The fermentation was slow and cool, attaining its maximum temperature of 78° on the fourth day, and finishing on the sixth day.

The wine was racked twice during the first two months, but was slow in clearing. At three months it was bright, with a slight bouquet, but very little flavor, high acid, and somewhat suspicious after-taste—generally of poor quality and without character. At five months the lees showed a little lactic ferment, and the wine was pasteurized. At seven months the wine was bright, had improved somewhat in taste and bouquet, but tasted green, and was without much character. At fourteen months the wine was mature, and at sixteen months it was bottled. At two years the wine was examined and found to be bright; it was thin and neutral, but smooth and somewhat agreeable.

No. 1430. *Verdal*, from J. Gallegos, Mission San José. A sample for must analysis was received October 30, 1890, in good condition, and mature. The must showed 22.15% of solid contents by spindle.

No. 1453. *Verdal*, from Tulare station. Received August 29, 1891, in good condition, but not ripe. The must showed 18.82% of solid contents by spindle. The fermentation lasted five days, was cool and complete, and reached its maximum temperature of 76° on the third day.

The wine remained cloudy for some time, but was bright at seven weeks after crushing. During the first three months it was racked twice, and at four months it was bright, water-white, with a little bouquet—generally neutral, but drinkable, and well advanced for its age. Tastings at six and eight months showed it to have improved somewhat and to have kept perfectly. At fourteen months the wine was mature, thin, and without character; at this age it was bottled.

No. 1705. *Verdal*, from Tulare station. Received October 5, 1892, in excellent condition. The grapes were of very large size, and mature. The must showed 20.4% of solid contents by spindle. The fermentation was somewhat slow, lasting eight days, and reaching its maximum temperature of 83° on the third day.

At one month the wine was clear, fresh-tasting, and quite dry; it was racked twice during the first three months, and at the end of that time was bright, with some bouquet and flavor, a nutty taste, and signs of early maturity. It remained bright, sound, and generally in good order for sixteen months, when it was bottled.

No. 1912. *Verdal*, from Tulare station. Received October 6, 1893, in fairly good condition—a trifle bruised, but not at all moldy. The must showed 18.80% of solid contents by spindle. The amount received (752 lbs.) was divided into three lots, one of which was fermented in the ordinary way, and the others with special ferments. The normal fermentation, which was made for comparison, was prompt and thorough, lasting four days, and attaining a maximum temperature of 81° on the second day.

The wine was clean-tasting, and nearly clear three weeks after crushing. Four months after the first drawing-off it was bright, with full acid, but with little flavor and no bouquet. Three months later it had made little change.

No. 1964. *Verdal*, from Paso Robles station. A sample for must analysis arrived October 14, 1893, in fair condition. The bunches were large, irregular, and compact; the berries large (smaller than those from Tulare), and not quite ripe. The must showed 22.85% of solid contents by spindle.

No. 1982. *Verdal* (*Napoleon*), from Tulare station. Received October 19, 1893, in good condition. Bunches and berries both extremely large; berries not very sweet, but riper than those received under the name of Verdal from the same station (No. 1912). The must showed 19.3% of solid contents by spindle. The must fermented quickly, reached a temperature of 82° on the third day, and was dry on the fourth.

The wine cleared quickly, and three months from crushing, when it had been racked twice, it was bright and clean-tasting. Six months after making, it was in good condition, fresh-tasting, and agreeable, but with little character.

No. 2082. *Verdal*, from Paso Robles station. Received November 4, 1893, in good condition. The bunches were very irregular in size and shape, large, and either loose or compact; the berries were large to very large, sweet, with very little flavor. The must showed 22.7% of solid contents by spindle. The fermentation was rather slow and cool, the temperature not rising above 77°.

The wine was clear at five weeks, having been racked twice. At ten weeks it was bright, clean-tasting, with some bouquet and flavor, and medium acid. At six months it was smooth and agreeable, with some bouquet, but no marked character.

CHAUCHÉ GRIS.

(See Vit. Rept. 1885–86, p. 101.)

Synonyms: Gray Riesling; Gray D'Ischia (in California).

Description.—A strong, vigorous grower, with abundant foliage; canes thick, with short internodes; leaves of medium size, circular outline, with shallow sinuses or without any, glabrous above, soft-downy below; bunches small, conical, shouldered, compact; berries small, ellipsoidal, from greenish-pink to reddish, with abundant bloom.

This variety has been planted pretty extensively, is vigorous in almost all localities, and generally fairly resistant to disease, except where *oidium* is prevalent, in which places it needs several sulphurings. The vines require long-pruning, but when trained in the usual way the crop is often a total failure, on account of coulure. This tendency to coulure can be overcome by the Guyot system of pruning; the canes tied to the horizontal wires must be very long, and renewed every year. The grapes ripen early, and generally color well; they are very hard and difficult to press. In general, the must is very high in sugar and rather low in acid; it is difficult to ferment, and very slow to clear, especially if it has been allowed to remain for any length of time in contact with the skins.

The localities where this grape has given the most satisfaction are in the higher parts of the Santa Cruz Mountains. Here the sugar content is lower and the acid higher than in the other localities, where it averages 25% of sugar and 0.45% of acid. In favorable localities it gives a wine of good bouquet, clean taste and full body, and produces, when properly pruned, at the rate of 5 to 6 tons per acre. The average crop at Cupertino on the long-pruned vines has been 5.7 tons per acre, while on the short-pruned it has been only 0.4 ton. It has borne well at the Amador station, but in composition the must has been too high in sugar and too low in acid to promise well for a dry wine.

TABLE OF PRODUCTION.

CHAUCHÉ GRIS.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 694 (long-pruned). J. T. Doyle, Cupertino	20	172	8.6	Oct. 4
No. 707 (short-pruned). J. T. Doyle, Cupertino	20	15	0.7	Oct. 10
1888—No. 882 (long-pruned). J. T. Doyle, Cupertino	20	386	19.3	Oct. 3
No. 883 (short-pruned). J. T. Doyle, Cupertino	20	30	1.5	Oct. 3
1889—No. 1101. J. T. Doyle, Cupertino	20	450	22.5	Sept. 26

ANALYSES OF MUSTS AND WINES.

CHAUCHÉ GRIS.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
1883—No. 92. Charles King, St. Helena		20.94	21.38	.51	.33	10.07	12.54	.68		1.42	.23
No. 92*a*.† Charles King, St. Helena		20.94	21.38	.51	.33	8.91	11.10	‡.63		1.93	.38
No. 93. W. G. Klee, Glenwood		18.96	19.89	.52	.29	9.27	11.54	.60		1.53	.17
No. 93*a*.† W. G. Klee, Glenwood		18.96	19.89	.52	.29	9.05	11.27	§.63		1.73	.25
1884—No 117.* R. Barton, Fresno						9.20	11.45	.66		2.05	.28
1885—No. 359. W. G. Klee, Glenwood		22.80		.41	.28	10.54	13.00	.35		1.80	.25
1886—No. 489. J. T. Doyle, Cupertino		20.90	20.65	.50	.36	8.13	10.17	.55		1.80	
No. 540. J. S. Fowler, Patchen		22.00	21.38	.43	.41	8.77	10.91	.38		1.90	
1887—No. 682. Margherita Vineyard, Fresno	Aug. 29	24.80	24.12	.57	.40	10.81	13.27	.50	.08	2.80	
No. 694 (long-pruned). J. T. Doyle, Cupertino	Oct. 4	25.13	26.31	.50	.39	10.91	13.36	.43		2.50	
No. 707 (short-pruned). J. T. Doyle, Cupertino	Oct. 10	28.78	28.33	.45	.40						
1888—No 839. J. Gallegos, Mission San José	Sept. 10	25.52		.42							
No. 882 (long-pruned). J. T. Doyle, Cupertino	Oct. 3	23.32	23.62	.32	.41	9.70	12.09	.53		2.00	
No. 883 (short-pruned). J. T. Doyle, Cupertino	Oct. 3	24.92	26.00	.29	.49						
1889—No. 1030. Margherita Vineyard, Fresno	Aug. 29	31.10	30.63	.60	.91						
No. 1084. J. Gallegos, Mission San José	Sept. 16	25.90	25.76	.48	.50	10.72	13.18	.37		2.45	
No. 1096. Margherita Vineyard, Fresno	Sept. 16	28.00	27.75	.37	.59	13.15	16.20	.30		3.35	
No. 1101. J. T. Doyle, Cupertino	Sept. 26	25.55		.39							
1890—No. 1207. Margherita Vineyard, Fresno	Aug. 11	22.82	22.67	.48	.50	8.90	11.18	.22		2.15	
No. 1286. J. T. Doyle, Cupertino	Oct. 1	25.44		.36							
1891—No. 1495. Paso Robles	Sept. 13	25.20		.38							
No. 1499. Asti, Sonoma County	Sept. 14	24.80	24.12	.41	.28	9.63	12.00	.44		3.15	
No. 1509. Mission San José	Sept. 24	25.40	25.76	.44		10.63	13.09	.30		2.45	
1892—No. 1649. Paso Robles	Sept. 13	25.20		.45							
No. 1774. Mission San José	Oct. 14	24.80	23.60	.44		9.56	11.91	.60		2.50	
1893—No. 1801. Amador station	Aug. 30	21.30		.72							
No. 1864. Paso Robles	Sept. 13	23.30	22.60	.50	.36	9.06	11.27	.49		2.30	
No. 1987. Mission San José	Oct. 19	25.95	25.19	.52		11.46	14.00	.58		2.60	
No. 2096. Cupertino	Nov. 6	25.20		.36							
1894—No. 2145. Amador station	Sept. 11	25.50		.45							
No. 2240. Mission San José	Oct. 3	25.85		.48							

*Wine sent for examination. †Fermented with skins. ‡Acid at pressing, 0.43%. §Acid at pressing, 0.44%; tannin, 0.035%.

RECORD OF TREATMENT.

No. 682. *Chauché gris*, from Margherita Vineyard, Fresno. Received August 31, 1887, in fair condition. The bunches were large and looser than those from Cupertino; the berries also large and deeply colored. The must showed 24.8% of solid contents by spindle and 0.57% of acid. The temperature of the grapes at crushing was 63°, and the maximum reached was 78°, on the fifth day. The fermentation was slow, and lasted about seventeen days.

At three weeks the wine was drawn off the thick lees. Three months later it was still turbid, and showed indications of secondary fermentation. A microscopic examination of the lees confirmed the indications of the taste, so the wine was racked and pasteurized. A month later it was bright, and had developed some bouquet; it had medium body and adequate acid. The wine as a whole was pleasant and of good quality, except for a rather unpleasant after-taste.

No. 694. *Chauché gris*, from J. T. Doyle, Cupertino. Received October 6, 1887, in good condition. The bunches were well filled, and the berries of good size for the variety, and deeply colored. The must showed 25.13% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 71°, and the maximum reached was 88°, on the third day.

At two weeks the wine was drawn off the heavy lees. At two months it was bright, with light acid and aroma, and a fairly well-developed wine. A month later it was racked again; it had developed a little bouquet, but the acid tasted a little sharpish. A microscopic examination of the lees showed some unsound ferments, so the wine was racked again two weeks later, and pasteurized.

No. 707. *Chauché gris*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 11, 1887, in good condition. The grapes were from short-pruned vines, and did not differ materially from those from long-pruned vines. They showed rather more coulure and there were more dried grapes, on account of the hot days immediately preceding their gathering. The must showed 28.78% of solid contents by spindle and 0.45% of acid.

No. 839. *Chauché gris*, from J. Gallegos, Mission San José. A sample for must analysis was received September 12, 1888, in good condition. The must showed 25.52% of solid contents by spindle and 0.42% of acid.

Nos. 882 (long-pruned) and 883 (short-pruned). *Chauché gris*, from J. T. Doyle, Cupertino. Received October 5, 1888, in good condition. The must of the grapes from long-pruned vines showed 23.32% of solid contents by spindle and 0.32% of acid. The grapes from short-pruned vines showed a great deal of coulure, and the must showed 24 92% of solid contents by spindle and 0.29% of acid. The two lots were fermented together. The maximum temperature, reached the fourth day, was 89°. The wine was quite dry on the tenth day, when it was drawn off the thick lees.

At three months the wine was not quite clear, but showed good aroma. Two months later it was pasteurized, on account of the presence of small quantities of unsound ferments in the lees. At eleven months it was clear and of fair quality, but with a slightly suspicious odor. At seventeen months it had deteriorated and become slightly bitter. It was racked again at this time, but did not improve.

No. 1030. *Chauché gris*, from Margherita Vineyard, Fresno. A sample for must analysis was received September 2, 1889, in good condition. The must showed 31.1% of solid contents by spindle and 0.60% of acid.

No. 1084. *Chauché gris*, from J. Gallegos, Mission San José. Received September 19, 1889, in good condition, and completely mature. The must showed 25.9% of solid contents by spindle and 0.48% of acid. The maximum temperature reached by the fermenting must was 83°, on the third day. The wine was dry on the sixth day.

At one month the wine was almost clear, clean-tasting, and with pleasing aroma. Eight days later it was clear, and in two weeks was taken to the cellar. At four months it was clear, of light golden color, with marked and agreeable aroma, rather raw still, but of good general quality. At seven months it was racked for the third time. It became cloudy, and showed signs of secondary fermentation, so it was submitted to electrical treatment for an hour. Two months later the wine tasted exhausted, and had evidently not been benefited by the treatment, as it steadily deteriorated after this.

No. 1096. *Chauché gris*, from Margherita Vineyard, Fresno. Received September 20, 1889, in good condition, but overripe. The bunches were larger and looser than usual; the berries softer and more juicy than those of the same variety from Mission San José. The skin was almost rose-colored. The must showed 28.0% of solid contents by spindle and 0.37% of acid. The fermentation reached its maximum on the third day at a temperature of 79.5°. The wine was nearly dry on the fifth day.

At one month the wine was racked and taken to the cellar. It was bright, of light golden-yellow color, of faint flavor and aroma, full body, medium acid, and good general quality. At four months it was bright, full-bodied, and rather rough for a white wine. Three months later it was pasteurized, as the lees showed signs of unsound ferments. There were traces of sugar in the wine, which started the secondary ferments again later, so that the wine did not improve. At one year the wine, which had been kept in demijohn since it was pasteurized, was fairly good, but the wine in the keg was bitter. After this it did not improve.

No. 1101. *Chauché gris*, from J. T. Doyle, Cupertino. A sample for must analysis was received September 27, 1889, in good condition, and quite ripe. The bunches were of medium size, cylindrical, sometimes shouldered, close; the berries of normal size, firm and not juicy, sweet and agreeable. The must showed 25.55% of solid contents by spindle and 0.39% of acid.

No. 1207. *Chauché gris*, from Margherita Vineyard, Fresno. Received August 14, 1890, in fairly good condition. Bunches compact and of fair size; berries firm, and completely mature. The must showed 22.82% of solid contents by spindle, and reached its maximum temperature of 79° on the fourth day; the fermentation was slow and prolonged.

Six weeks after crushing the wine was nearly clear, but still a little sweet and fermenting. At ten weeks the wine was quite clear, with pleasing but neutral flavor, good body and alcohol, medium acid, but no bouquet. It was racked four times the first year, but after six months commenced to deteriorate, becoming flat and insipid. At fourteen months it was bottled, but failed to keep in glass.

No. 1286. *Chauché gris*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 3, 1890, in fair condition; a few grapes moldy, quite ripe. The must showed 25.43% of solid contents by spindle.

No. 1495. *Chauché gris*, from Paso Robles station. A sample for must analysis arrived September 16, 1891, in good condition. The grapes were mature and very small. The must showed 25.2% of solid contents by spindle.

No. 1499. *Chauché gris*, from Asti, Sonoma County. Received September 17, 1891, in good condition, well-colored, and mature. The must showed 24.8% of solid contents by spindle. The fermentation was very feeble and slow, the must never rising more than 2° above the temperature of the room.

At the end of a month the wine was still sweet and fermentation had almost stopped; it was then treated with half a gallon of sediment from No. 1601, a White Vernaccia from Cupertino in full fermentation, and then aërated. Fermentation recommenced, and in four days the wine was almost dry. It never became quite clear, and at four months commenced to show signs of bad acid, and was therefore pasteurized. At six months it was racked, and at eight months it was quite bright, though still a little sweet. At ten months it was racked and lightly sulphured. At fourteen months it was bright, still slightly sweet, but quite sound and fairly agreeable. At fifteen months it was bottled.

No. 1509. *Chauché gris*, from Mission San José. Received September 27, 1891, in fair condition; a little moldy. The must showed 25.4% of solid contents by spindle. The must went through promptly in five days, reaching its maximum temperature of 81° on the third day.

The wine was a little slow in clearing, but was clear two months after crushing. It was racked twice during the first three months, and at the end of that time was bright, of fair quality, but slightly bitter. Eight months after crushing it was much improved, smooth, full-bodied, and pleasing. At fifteen months the wine had not developed much bouquet, but was mature, and was bottled.

No. 1649. *Chauché gris*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 25.2% of solid contents by spindle.

No. 1774. *Chauché gris*, from Mission San José. Received October 15, 1892, in good condition. The must showed 24.8% of solid contents by spindle. The fermentation reached its maximum temperature of 82° on the fourth day, and continued slowly for some time, and was slow in clearing.

The wine was racked twice during the first two months, and at three months was bright, had full flavor and a little bouquet, but was not quite clean-tasting. Tastings at five, eight, and ten months showed a gradual improvement and a quick maturing. At eighteen months the wine was bottled.

No. 1801. *Chauché gris*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition. The bunches were small and well filled. The must showed 21.3% of solid contents by spindle.

No. 1864. *Chauché gris*, from Paso Robles station. Received September 15, 1893, in good condition. The bunches were very compact and large; the berries were large for the variety, unevenly ripened. The must showed 23.3% of solid contents by spindle. The must reached its maximum temperature of 82° on the fourth day, and fermented through in seven days.

The wine cleared in three weeks, and was racked twice during the first month. At four months it was bright, full-bodied, with a little flavor and bouquet, but still very raw. At eight months it was much improved, had acquired a good bouquet, a clean, sound after-taste, and was altogether an agreeable wine.

No. 1987. *Chauché gris*, from Mission San José. Received October 19, 1893, in good condition, very ripe, and more deeply colored than usual. The must showed 25.95% of solid contents by spindle. The must fermented slowly, and did not attain its maximum temperature of 81° until the fourth day; in eight days it was nearly dry.

At one month the wine was nearly clear, and was racked for the second time. At three months it was bright, but very raw. At seven months it was smoother, full-bodied, but quite clean-tasting.

No. 2096. *Chauché gris*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The bunches were small and compact; the berries small, deeply colored, overripe, but with good acid. The must showed 25.2% of solid contents by spindle.

BURGER.

(See Vit. Rept. 1883-85, p. 124; 1885-86, p. 93.)

Synonyms: White Tokay; Putszcheere; Elender.

The Burger, properly so called, is a grape of the northern part of the wine belt of Europe, and the grape passing under that name in California has been associated, both in the vineyards and cellars, with the (true) Riesling, the Gutedel or Chasselas, and other Rhenish grapes. Among these, it is in Europe held in but very light estimation as to quality, though known to produce large quantities of a light acid wine, poor in alcohol. Among its names is that of White Elbling; the Blue Elbling, largely cultivated by Mr. L. J. Rose at San Gabriel, being held to be one of its varieties.

However similar to the true Burger, or Kleinberger, in respect to the wine it yields, especially in northern localities, the California grape differs from the German type as well as from the Blue Elbling. From a comparison with a grape imported by Mr. Groezinger, Mr. Wetmore identifies our grape with the White Tokay, also known as Putszcheere, and Elender; both names indicative of no very high estimate of the variety, which seems to represent the Burger in Hungary.

This variety has been so extensively planted and is so well known in California that an extended description is unnecessary. It succeeds well in all localities which are not too late to ripen its grapes, bearing immense crops where the soil is rich, and good crops wherever vines will thrive at all.

Description.—Vine rather a small grower; leaves of medium size or smaller, the lateral sinuses well marked, often closed, the petiolar sinus narrow, dentation very obtuse, sometimes almost sinuate; the upper surface of leaves glabrous, the lower sparsely downy; bunch very large, irregular, generally very compact; berries a little over medium size, round, very juicy, and without special flavor.

The skin of the grapes is very easily broken, rendering them susceptible to damage by early rains. In the northern coast counties the variety produces a light acid wine of fair quality when planted in a warm and early location, but the best results have been obtained with it in the warmer southern and central counties. In Fresno and Tulare counties it attains very regularly from 20% to 23% of sugar, with from 0.6% to 0.4% of acid, ferments well, and produces one of the best white wines of those localities. In San Luis Obispo County it has also done well, retaining good acid with a fair amount of sugar. In the Sierra foothills it has not been so satisfactory; and in the northern coast counties it is too much at the mercy of early autumn rains and late seasons; for, though a clean, neutral wine of good keeping qualities is sometimes obtained from it, at other times, and more often, it gives a thin, watery, green-tasting wine, good only for distillation.

The crops reported as obtained from this variety vary from 2 tons (exceptionally small) in a red hill soil of Napa County, to 11 tons or more in rich soils. About 7 tons to the acre would seem to be about the average in ordinary soils. The average for three years at Cupertino has been 9.3 tons per acre.

Burger is preëminently a blending wine, especially useful as an addition to such wines as the Chauché gris, which it improves in acid and keeping qualities; it is also, on account of its neutral character, of use as a toning-down blend with wines of too strongly marked character, being often used as a diluent with red wines too rich in color, tannin, or special flavor. One of its especial merits is the ease with which it maintains and imparts to other musts a sound fermentation.

TABLE OF PRODUCTION.

BURGER.	Number of Vines....	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking........
1887—No. 748 (long-pruned). J. T. Doyle, Cupertino....	20	535	26.7	Oct. 18
No. 754 (short-pruned). J. T. Doyle, Cupertino....	20	445	22.2	Oct. 19
1888—No. 940 (short-pruned). J. T. Doyle, Cupertino....	20	720	36.0	Oct. 25
No. 941 (long-pruned). J. T. Doyle, Cupertino....	20	515	25.7	Oct. 25
1889—No. 1165. J. T. Doyle, Cupertino..................	20	500	25.0	Oct. 14

Analyses of Musts and Wines.

BURGER.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash
1883—No. 112.* R. Barton, Fresno	......				......	9.12	11.36	.49	......	2.24	.37
1884—No. 113.* R. Barton, Fresno	......	......	......	......	......	8.98	11.17	.50	......	3.02	.26
No. 261. R. Barton, Fresno	......	20.06	19.96	.45	.45	8.55	10.63	.53	......	1.65	.18
No. 114.* L. J. Rose, San Gabriel	......	......	......	......	......	9.20	11.42	.40	......	2.16	.31
No. 261. Stern & Rose, San Gabriel	......	19.19	19.15	.51	.31	8.41	10.50	.60	......	2.05	.26
1885—No. 348. Leland Stanford, Vina	......	23.35	......	.39	.60	9.63	12.00	.68	......	2.69	.45
No. 349. C. Weller, Harrisburg	......	19.46	......	.80	.30	8.13	10.16	.65	......	1.93	.19
No. 362. H. Keatinge, Lower Lake	......	22.69	......	.47	.40	8.84	11.00	.54	......	1.68	.18
No. 366. D. C. Feeley, Patchen	......	12.62	......	.75	.32	4.76	6.00	.48	......	1.52	.23
1886—No. 471. Leland Stanford, Vina	Sept. 16	22.50	......	.50	.48	8.20	10.25	.75	......	1.80	......
No. 501. J. T. Doyle, Cupertino	Sept. 27	13.10	11.68	1.02	.09	3.96	5.00	.79	......	1.30	......
No. 508. R. Wegener, Livermore	Sept. 28	20.80	20.24	.44	.37	7.92	9.90	.40	......	2.05	......
No. 572.† J. D. Cone, Sacramento	......	24.00	24.33	.39	.39	......	......	......	......	......	......
1887—No. 748 (long-pruned). J. T. Doyle, Cupertino	Oct. 18	19.40	19.21	.65	.33	7.90	9.90	.54	.07	2.10	......
No. 754 (short-pruned). J. T. Doyle, Cupertino	Oct. 19	21.98	21.63	.81	.37	9.20	11.45	.66	.03	2.30	......
No. 692.* R. Wegener, Livermore	Sept. 28	22.87	22.67	.62	.42	8.98	11.18	.50	.02	2.30	......
No. 681. Margherita Vineyard, Fresno	Aug. 28	23.24	22.67	.45	.53	9.92	12.36	.50	.11	2.60	......
1888—No. 830. Margherita Vineyard, Fresno	Sept. 5	23.16	24.11	.34	.60	9.27	11.55	.58	......	2.10	......
No. 940 (short-pruned). J. T. Doyle, Cupertino	Oct. 25	19.13	19.75	.31	.39	7.64	9.54	.55	......	1.40	......
No. 941 (long-pruned). J. T. Doyle, Cupertino	Oct. 25	19.30	19.54	.63	.45						
1889—No. 1165. J. T. Doyle, Cupertino	Oct. 14	20.10	......	.63	......	......	......	......	......	......	......
No. 1173. J. Gallegos, Mission San José	Oct. 15	21.20	21.55	.47	.32	8.34	10.42	.43	......	2.35	......
1890—No. 1279. J. T. Doyle, Cupertino	Sept. 29	19.30	......	.87	......	......	......	......	......	......	......
No. 1383. J. Gallegos, Mission San José	Oct. 17	20.20	......	.68	.34	9.20	11.45	.50	......	2.44	......
1891—No. 1449. Tulare	Aug. 28	21.50	......	.53	......	......	......	......	......	......	......
No. 1539. Paso Robles	Oct. 6	23.70	......	.45	......	......	......	......	......	......	......
No. 1565. Mission San José	Oct. 6	20.60	......	.68	......	8.17	10.91	.62	......	2.30	......
1892—No. 1644. Paso Robles	Sept. 14	19.05	......	.80	......	......	......	......	......	......	......
No. 1660. Amador station	Sept. 16	21.10	......	.60	......	......	......	......	......	......	......
No. 1667. Tulare	Sept. 16	19.60	......	.56	.36	7.78	9.73	.51	......	2.35	......
No. 1773. Mission San José	Oct. 13	20.70	19.21	.79	......	8.84	11.00	.55	......	2.20	......

1893—No. 1839.	Amador station	Sept. 6	15.20	......	.91	......	......	......	......	......	......	......
No. 1861.	Amador station	Sept. 13	17.70	......	.90	......	......	......	......	......	......	......
No. 1908.	Tulare	Oct. 3	20.00	19.21	.75	.44	7.75	9.70	.45	......	2.60	......
No. 2008.	Paso Robles	Oct. 25	22.05	21.40	.45	.39	8.84	11.00	.45	......	2.30	......
No. 2061.	Mission San José	Nov. 1	22.60	21.63	.79	.23	9.34	11.64	.71	......	2.15	......
No. 2085.	Cupertino	Nov. 6	17.20	......	.99	......	......	......	......	......	......	......
No. 2190.	Amador station	Sept. 25	24.35	......	.38	......	......	......	......	......	......	......
No. 2217.	Paso Robles	Sept. 28	22.80	......	.68	......	......	......	......	......	......	......
No. 2241.	Mission San José	Oct. 5	18.80	......	.69	......	......	......	......	......	......	......
No. 2315.	Amador station	Oct. 15	25.40	......	.41	......	......	......	......	......	......	......
No. 2333.	Tulare	Oct. 19	21.90	20.10	.55	......	8.13	10.17	.39	......	2.45	......

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*Wines sent for examination. †Condensed must.

RECORD OF TREATMENT.

No. 681. *Burger*, from Margherita Vineyard, Fresno. Received August 31, 1887, in good condition. The bunches were large, well filled, and without coulure; the berries were large, thick-skinned, and with good acid. The must showed 23.24% of solid contents by spindle and 0.45% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 78°, on the fifth day. The wine was dry on the tenth day, and was drawn off.

At three weeks the wine was drawn off the thick lees, and a month later it was clear, with some aroma and pleasing quality. At three months an examination of the lees showed them not to be quite sound, so the wine was drawn off and pasteurized. At nine months the wine was bright, and had developed some bouquet, but was not quite clean-tasting. At this time it was racked again.

No. 692. *Burger*, from R. Wegener, Livermore. Received October 1, 1887, in good condition. But few of the bunches were compact, many of them showing coulure; the berries were generally small, and very sweet. The must showed 22.87% of solid contents by spindle and 0.62% of acid. The temperature of the grapes at crushing was 73°, and the maximum reached was 86°, on the eighth day. The fermentation was complete on the thirteenth day, when the wine was drawn off.

At three months the wine was bright, and showed better aroma but less body than No. 681, the Fresno sample. Two weeks later it was racked again. At seven months, as the lees showed some unsound germs, the wine was drawn off and pasteurized. At eight months it was bright, light-bodied, with some bouquet, but flat and neutral, and generally inferior to the Fresno sample.

No. 748. *Burger*, from J. T. Doyle, Cupertino. Received October 19, 1887, in good condition. The grapes were from long-pruned vines. The bunches were large, well filled, and showed no coulure; the berries were sweet, thin-skinned, and many bronzed by the sun. The must showed 19.4% of solid contents by spindle and 0.65% of acid. The temperature of the grapes at crushing was 61°, and the maximum reached was 83°, on the second day.

In sixteen days the wine was drawn off the lees, and at seven weeks it was clear, with medium acid, but watery and without aroma. Two weeks later it was racked again. At six months the sediment showed unsound ferments, and was racked off and pasteurized. At eight months the wine was bright and very much improved; it had developed some bouquet, and was a good wine for a Burger.

No. 754. *Burger*, from J. T. Doyle, Cupertino. Received October 20, 1887, in good condition. The grapes were from short-pruned vines. The bunches were of extremely large size; the berries very large, juicy, and much more agreeably flavored than the grapes from long-pruned vines. The must showed 21.98% of solid contents by spindle and 0.81% of acid. The temperature of the grapes at crushing was 71°, and the maximum reached was 86°, on the third day. In two weeks the wine was quite dry, and was drawn from the lees.

At two months the wine was clear, with fair aroma, medium acid, somewhat thin, but of fair quality Ten weeks later it had a suspicious taste, so it was drawn off and pasteurized. At eight months it was bright, with well-developed bouquet, of fair body, and slightly sharp acid.

No. 830. *Burger*, from Margherita Vineyard, Fresno. Received September 8, 1888, in excellent condition. The bunches were large and full; the berries juicy and very sweet, with moderately thick and rather tough skin. The must showed 23.16% of solid contents by spindle and 0.34% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 81.5°, on the sixth day. On the twelfth day the fermentation was over, and the wine was drawn off.

At seven weeks the wine was racked again and taken to the cellar. At four months the wine was not clear, but it tasted good. Two months later it was racked again, and an examination of the lees showed no unsound germs. After this the wine did not improve much, but became clear. At seventeen months it was bright, and showed some bouquet; after this it deteriorated. At twenty-three months it was put in glass. At twenty-nine months the wine bottled at fifteen months was not quite bright, and was of poor quality; that bottled at twenty-three months was bright, and of better quality. The former did not improve in glass, but the latter nineteen months later was of fair quality, sound, bright, and drinkable.

No. 940. *Burger*, from J. T. Doyle, Cupertino. Received October 26, 1888, in good condition. The grapes were partly from long-pruned and partly from short-pruned vines. Those from the short-pruned vines were the best and showed the less coulure. The must showed 19.13% of solid contents by spindle and 0.31% of acid for the short-pruned, and 19.3% of solid contents by spindle and 0.63% of acid for the long-pruned. The temperature of the grapes at crushing was 67°, and the maximum reached was 83.5°, on the second day. On the tenth day the fermentation was over, and the wine was drawn off.

At two months the wine was clear, of somewhat better aroma than the Burger from Fresno, but light and thin. Two months later an examination of the lees showed them to be sound. At eleven months the wine was in good condition, and rather agreeable. Six months later the lees showed many old bitter ferments; the wine was bright, but had a slightly bitter flavor and had deteriorated since the last tasting; it was racked and part put in bottle. At twenty-two months the lees showed no bad germs; the wine was in good condition, of agreeable flavor, medium acid, poor aroma, fair quality, and mature. A month later it was put in bottle. At two years and four months the wine bottled at seventeen months was bright, with light deposit in bottle, no bouquet, little flavor, rather fresh, and agreeable. That bottled at twenty-three months was bright, but tasted as if exhausted, and lacked the freshness of the other.

No. 1165. *Burger*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 15, 1889, in fair condition. The bunches were large, cylindrical, compact; the berries over average in size, irregular, soft, juicy, and watery-tasting. The must showed 20.1% of solid contents by spindle and 0.63% of acid.

No. 1173. *Burger*, from Mission San José. Received October 16, 1889, in fair condition. The bunches were large and very compact, maturity complete. The must showed 21.2% of solid contents by spindle and 0.47% of acid. The temperature of the grapes at crushing was 63.5°, and the maximum reached was 81.5°, on the third day. On the fifth day the wine was drawn off, being quite dry.

At two months the wine was not quite clear; it showed medium acidity and body, fair quality, but was lacking in flavor and aroma. At this time it was racked for the second time and taken to the cellar. Six weeks later it had improved very much; it was bright, but lacked character. Four months later it showed signs of unsoundness, and was pasteurized. Tastings at eight and at ten months showed improvement and the development of some bouquet. After this the wine deteriorated, and showed that it had attained its maturity at from ten to twelve months.

No. 1279. *Burger*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 2, 1890, in good condition. The bunches and grapes were large and fine, but the latter were not quite ripe. The must showed 19.3% of solid contents by spindle.

No. 1383. *Burger*, from Mission San José. Received October 20, 1890, in a somewhat bruised condition and a little moldy. The must showed 20.2% of solid contents by spindle. The fermentation lasted seven days, with a maximum temperature of 80° on the fourth day.

The wine was racked twice during the first month, but did not clear very quickly. At one month it was a light, pleasant wine, but not quite clear, and with a slight taste of mold. The lees were examined at intervals, but no unsound germs were found. At three months the wine was clear, and was racked; it had a light, pleasant bouquet, somewhat disguised by moldiness. At eighteen months the wine tasted mature, so part was bottled, the remainder being bottled at two years. Fourteen months after the second bottling, both samples were tasted; they were both bright, and the second a very agreeable wine, but lacking in bouquet; the first was not quite clean-tasting.

No. 1449. *Burger*, from Tulare station. A sample for must analysis arrived August 29, 1891, in good condition, but not mature. The must showed 21.5% of solid contents by spindle.

No. 1539. *Burger*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition. The bunches were of medium size, well filled, with medium-sized berries. The must showed 23.7% of solid contents by spindle.

No. 1565. *Burger*, from Mission San José. Received October 9, 1891, in fair condition. The must showed 20.6% of solid contents by spindle. The fermentation was slow and cool, lasting ten days, and remaining at its maximum temperature of 77° from the fourth to the sixth day.

In six weeks the wine was clear and clean-tasting. It was racked twice during the first three months, and at five months was bright, without much bouquet or flavor, but clean-tasting and with full and agreeable acid. At eight months it was smooth and pleasing, and had developed well. At fifteen months it was mature, in good order, a very pleasing wine, but with little character; at this age it was bottled.

No. 1644. *Burger*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 19.05% of solid contents by spindle.

No. 1660. *Burger*, from Amador station. A sample for must analysis was received September 19, 1892, in poor condition. The must showed 21.1% of solid contents by spindle.

No. 1667. *Burger*, from Tulare station. A very fine lot of grapes was received September 19, 1892, in good condition. The must showed 19.6% of solid contents by spindle. The must fermented well and reached its maximum temperature of 80° on the fourth day.

In one month the wine was dry, clear, and clean-tasting; it was racked twice during the first two months. At four months the wine was bright, smooth, and fresh-tasting, but lacking in bouquet. At nine months the wine was in good order, and, though lacking in delicacy, the best of the Tulare white wines of this year. After this the wine deteriorated.

No. 1773. *Burger*, from Mission San José. Received October 15, 1892. The must showed 20.7% of solid contents by spindle. The fermentation was rather slow in starting, as the grapes were crushed at 58°; it reached its maximum temperature of 79° on the fourth day, and continued about eleven days, when the wine was nearly dry.

In three weeks the wine was nearly clear and quite dry; it was racked twice during the first two months, and at three months was bright, clean-tasting, and with full acid. Tastings at five, eight, ten, and thirteen months showed a gradual improvement and the development of a little bouquet. The wine kept well, and while lacking in character was clean-tasting and pleasant.

No. 1839. *Burger*, from Amador station. Received September 8, 1893, in good condition. The grapes were generally of good size, but some bunches had many abortive berries; they were not mature. The must showed 15.2% of solid contents by spindle.

No. 1861. *Burger*, from Amador station. Another sample for must analysis arrived September 15, 1893, in good condition, but not mature. The bunches were large, and the berries very irregular in size. The must showed 17.7% of solid contents by spindle.

No. 1908. *Burger*, from Tulare station. Received October 5, 1893, in good condition, except for a few moldy bunches. The bunches and berries were very large and well ripened. The must showed 20.0% of solid contents by spindle. The fermentation was quick and thorough, reached its maximum temperature of 89° on the third day, and was through on the fifth.

At the end of the first month the wine was nearly clear, dry, and clean-tasting. Tastings at four, six, and eight months showed a general toning-down and increase of brightness, but the wine was completely neutral and almost without flavor or bouquet.

No. 2008. *Burger*, from Paso Robles station. Received October 26, 1893, in good condition. The bunches were large, irregular, loose, but well filled; the berries a little over medium in size. The grapes were quite mature. The must showed 22.05% of solid contents by spindle. The fermentation lasted nine days, and was cool, the temperature never going above 75°.

The wine cleared quickly, and was racked twice during the first two months. At seven months the wine was bright, clean-tasting, with moderate acid and neutral flavor.

No. 2061. *Burger*, from Mission San José. Received November 1, 1893, in good condition, and mature. The must showed 22.6% of solid contents by spindle. The fermentation was slow and cool, reaching its maximum temperature of 78° on the fourth day.

The wine became bright soon after the first racking, and at three months after crushing was a clean-tasting, neutral wine, with full acid.

No. 2085. *Burger*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The must showed 17.2% of solid contents by spindle.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF WHITE SOUTHERN FRENCH TYPE.

Number	LOCALITY.	Vintage of	MUST.			WINE.			
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Months	Body
	Clairette blanche.								
264	Natoma	1884	21.34	21.07	.45	.31	13.00	.43	1.85
481	Mission San José	1886	17.50	17.22	.53	.28	8.85	.55	2.10
510	Mission San José	1886	20.00	--------	.87	------	--------	------	------
513	Mission San José	1886	19.30	--------	.56	------	8.61	.47	1.58
535	Mission San José	1886	21.50	20.76	.86	.36	10.00	.51	1.80
535a	Mission San José	1886	21.50	20.76	.86	.36	9.82	.57	1.92
771	Mission San José	1887	25.45	25.20	.45	.35	12.36	.61	2.20
948	Mission San José	1888	23.32	22.22	.26	.28	11.27	.55	1.80
1170	Mission San José	1889	22.40	22.67	.41	.35	11.55	.40	2.55
1420	Mission San José	1890	26.30	--------	.54	.21	13.27	.42	2.78
2065	Mission San José	1893	24.80	--------	.54	------	--------	------	------
2225	Mission San José	1894	20.60	19.21	.62	------	--------	.64	------
2345	Mission San José	1894	20.85	--------	.39	------	--------	------	------
1196	Cupertino	1889	18.15	17.17	.34	.45	8.70	.42	1.35
1398	Cupertino	1890	21.10	--------	.53	------	--------	------	------
2029	Cupertino	1893	22.40	--------	.50	------	--------	------	------
1543	Paso Robles	1891	24.80	--------	.45	------	--------	------	------
1748	Paso Robles	1892	22.20	--------	.32	------	--------	------	------

SUMMARY OF ANALYSES OF MUSTS AND WINES OF WHITE SOUTHERN FRENCH TYPE—Cont'd.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Months	Body
	Clarette blanche—Cont.								
1658	Amador station	1892	22.70	-------	.46	-----	-------	-----	-----
1838	Amador station	1893	18.00	-------	.71	-----	-------	-----	-----
1862	Amador station	1893	21.70	-------	.56	-----	-------	-----	-----
2192	Amador station	1894	24.15	-------	.39	-----	-------	-----	-----
1701	Tulare	1892	22.40	-------	.29	-----	-------	-----	-----
1969	Tulare	1893	22.90	21.38	.38	.30	11.45	.53	2.20
2339	Tulare	1894	25.00	-------	.34	-----	-------	-----	-----
	Average, Mission San Jose	------	**22.05**	**21.15**	**.57**	**.31**	**10.71**	**.52**	**2.09**
	Average, Cupertino	------	**20.55**	**17.17**	**.45**	**.45**	**8.70**	**.42**	**1.35**
	Average, Paso Robles	------	**23.50**	-------	**.38**	-----	-------	-----	-----
	Average, Amador station	------	**21.64**	-------	**.53**	-----	-------	-----	-----
	Average, Tulare	------	**23.43**	**21.38**	**.33**	**.30**	**11.45**	**.53**	**2.20**
	Marsanne.								
1412	Cupertino	1890	24.10	-------	.66	.27	12.82	.50	2.50
2097	Cupertino	1893	25.90	-------	.63	-----	-------	-----	-----
1619	Tulare	1892	25.65	23.67	.38	.45	*22.18	.43	3.66
2000	Tulare	1893	26.10	25.76	.41	.50	12.73	.43	2.90
2203	Tulare	1894	27.35	-------	.26	-----	-------	-----	-----
1856	Amador station	1893	23.70	-------	.48	-----	-------	-----	-----
2162	Amador station	1894	26.70	-------	.34	-----	-------	-----	-----
1960	Paso Robles	1893	24.10	-------	.24	-----	-------	-----	-----
	Average, Cupertino	------	**25.00**	-------	**.64**	**.27**	**12.82**	**. 0**	**2.50**
	Average, Tulare	------	-------	**24.71**	**.35**	**.47**	**12.73**	**. 3**	**2.90**
	Average, Amador station	------	**25.20**	-------	**.41**	-----	-------	-----	-----
	Chasselas doré.								
476	Cupertino	1886	17.50	-------	.40	.25	8.61	.41	-----
696	Cupertino	1887	23.17	23.61	.31	.33	11.64	.53	1.87
917	Cupertino. (Short-pruned)	1888	22.89	24.12	.20	.50	11.45	.38	2.25
918	Cupertino. (Long-pruned)	1888	22.24	22.67	.22	.33			
1267	Cupertino	1890	22.30	-------	.44	.29	-------	-----	-----
2086	Cupertino	1893	23.10	-------	.53	-----	-------	-----	-----
1112	Mission San José	1889	22.60	21.80	.25	.38	11.45	.28	2.28
1260	Mission San José	1890	21.93	-------	.40	.26	-------	-----	-----
1561	Mission San José	1891	22.15	-------	.40	-----	11.45	.39	1.80
1776	Mission San José	1892	20.85	21.38	.37	-----	11.00	.53	2.10
1948	Mission San José	1893	23.70	-------	.46	-----	-------	-----	-----
2247	Mission San José	1894	21.90	-------	.35	-----	-------	-----	-----
1448	Tulare	1891	24.53	-------	.18	-----	-------	-----	-----
1677	Tulare	1892	20.20	-------	.29	-----	9.90	.40	2.70
2324	Tulare	1894	22.15	-------	.21	-----	-------	-----	-----
	Average, Cupertino	------	-------	**23.46**	**.34**	**.36**	**11.54**	**.45**	**2.06**
	Average, Mission San Jose	------	**22.19**	**21.59**	**.37**	**.32**	**11.30**	**.40**	**2.06**
	Average, Tulare	------	**22.29**	-------	**.23**	-----	**9.90**	**.40**	**2.70**
	Ugni blanc.								
274	Natoma	1884	20.70	20.61	.59	.49	11.10	.51	2.00
785	Cupertino	1887	21.46	20.99	.87	.47	9.63	.56	2.60
954	Cupertino	1888	19.75	20.03	.50	.37	9.73	.45	2.30
1195	Cupertino	1889	22.80	21.80	.51	.29	11.45	.39	2.00
1405	Cupertino	1890	23.05	-------	.91	.34	11.27	.74	1.54
2026	Cupertino	1893	22.40	-------	1.00	-----	-------	-----	-----
1704	Tulare	1892	22.15	-------	.45	-----	-------	-----	-----
2352	Tulare	1894	23.30	-------	.36	-----	-------	-----	-----
1737	Paso Robles	1892	24.20	-------	.51	-----	-------	-----	-----
	Average, Cupertino	------	**21.89**	**20.94**	**.76**	**.36**	**10.52**	**.53**	**2.11**
	Average, Tulare	------	**22.72**	-------	**.40**	-----	-------	-----	-----

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* Fortified.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF WHITE SOUTHERN FRENCH TYPE—Cont'd.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Months	Body
	Verdal.								
367	Patchen	1885	14.91	-------	.53	.26	8.07	.52	1.80
585	Patchen	1886	17.00	15.11	.63	.47	8.46	.55	1.55
512	Livermore	1886	21.80	21.07	.38	.30	10.36	.41	1.80
701	Livermore	1887	22.84	23.22	.52	.37	10.75	.43	2.60
803	Glenwood	1887	20.65	20.10	.75	.40	-------	-----	-----
1164	Cupertino	1889	21.50	-------	.48	-----	-------	-----	-----
1361	Cupertino	1890	18.95	-------	.84	.22	9.73	.46	1.80
1188	Mission San José	1889	19.50	-------	.57	-----	-------	-----	-----
1430	Mission San José	1890	22.15	-------	.63	-----	-------	-----	-----
2233	Mission San José	1894	20.40	-------	.53	-----	-------	-----	-----
1453	Tulare	1891	18.82	18.30	.53	-----	8.07	.40	2.60
1705	Tulare	1892	20.40	19.75	.42	.43	11.00	.46	2.30
1912	Tulare	1893	18.80	17.70	.75	.39	9.27	.48	2.60
1982	Tulare	1893	19.30	18.46	.58	.25	9.54	.45	2.60
2342	Tulare	1894	19.30	17.99	.59	-----	-------	-----	-----
1964	Paso Robles	1893	22.85	-------	.52	-----	-------	-----	-----
2082	Paso Robles	1893	22.70	21.63	.51	.37	10.12	.51	2.25
	Average, Patchen	-----	**15.95**	**15.11**	**.58**	**.36**	**8.25**	**.53**	**1.67**
	Average, Livermore	-----	**22.32**	**22.14**	**.45**	**.33**	**10.55**	**.42**	**2.20**
	Average, Cupertino	-----	**20.22**	-------	**.66**	**.22**	**9.73**	**.46**	**1.80**
	Average, Mission San Jose	-----	**20.68**	-------	**.57**	-----	-------	-----	-----
	Average, Tulare	-----	**19.32**	**18.44**	**.57**	**.35**	**9.47**	**.47**	**2.52**
	Average, Paso Robles	-----	**22.77**	**21.63**	**.51**	**.37**	**10.12**	**.51**	**2.25**
	Chauché gris.								
92	St. Helena	1883	20.94	21.38	.51	.33	12.54	.68	1.42
93	Glenwood	1883	18.96	19.89	.52	.29	11.54	.60	1.53
359	Glenwood	1885	22.80	-------	.41	.28	13.00	.35	1.80
117	Fresno	1884	-------	-------	-----	-----	11.45	.66	2.05
682	Fresno	1887	24.80	24.12	.57	.40	13.27	.50	2.80
1030	Fresno	1889	31.10	30.63	.60	.91	-------	-----	-----
1096	Fresno	1889	28.00	27.75	.37	.59	16.20	.30	3.35
1207	Fresno	1890	22.82	22.67	.48	.50	11.18	.22	2.15
489	Cupertino	1886	20.90	20.65	.50	.36	10.17	.55	1.80
694	Cupertino. (Long-pruned)	1887	25.13	26.31	.50	.39	13.36	.43	2.50
707	Cupertino. (Short-pruned)	1887	28.78	28.33	.45	.40	-------	-----	-----
882	Cupertino. (Long-pruned)	1887	23.32	23.62	.32	.41	} 12.09	.53	2.00
883	Cupertino. (Short-pruned)	1888	24.92	26.00	.29	.49			
1101	Cupertino	1889	25.55	-------	.39	-----	-------	-----	-----
1286	Cupertino	1890	25.44	-------	.36	-----	-------	-----	-----
2096	Cupertino	1893	25.20	-------	.36	-----	-------	-----	-----
540	Patchen	1886	22.00	21.38	.43	.41	10.91	.38	1.90
839	Mission San José	1887	25.52	-------	.42	-----	-------	-----	-----
1084	Mission San José	1889	25.90	25.76	.48	.50	13.18	.37	2.45
1509	Mission San José	1891	25.40	25.76	.44	-----	13.09	.30	2.45
1774	Mission San José	1892	24.80	23.60	.44	-----	11.91	.60	2.50
1987	Mission San José	1893	25.95	25.19	.52	-----	14.00	.58	2.60
2240	Mission San José	1894	25.85	-------	.48	-----	-------	-----	-----
1499	Asti, Sonoma County	1891	24.80	24.12	.41	.28	-------	-----	-----
1495	Paso Robles	1891	25.20	-------	.38	-----	-------	-----	-----
1649	Paso Robles	1892	25.20	-------	.45	-----	-------	-----	-----
1864	Paso Robles	1893	23.30	22.60	.50	.36	11.27	.49	2.30
1801	Amador station	1893	21.30	-------	.72	-----	-------	-----	-----
2145	Amador station	1894	25.50	-------	.45	-----	-------	-----	-----
	Average, Glenwood	-----	**20.88**	**19.89**	**.46**	**.28**	**12.27**	**.47**	**1.67**
	Average, Fresno	-----	**26.68**	**26.29**	**.50**	**.60**	**13.02**	**.42**	**2.59**
	Average, Cupertino	-----	-------	**24.98**	**.39**	**.41**	**11.87**	**.50**	**2.10**
	Average, Mission San Jose	-----	**25.59**	**25.08**	**.48**	**.50**	**13.04**	**.46**	**2.50**
	Average, Paso Robles	-----	**24.57**	**22.60**	**.44**	**.36**	**11.27**	**.49**	**2.30**

SUMMARY OF ANALYSES OF MUSTS AND WINES OF WHITE SOUTHERN FRENCH TYPE—Cont'd.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Mos.	Body
	Burger.								
112	Fresno	1883	------	------	------	------	11.36	.49	2.24
113	Fresno	1884	------	------	------	------	11.17	.50	3.02
261	Fresno	1884	20.06	19.96	.45	.45	10.63	.53	1.65
681	Fresno	1887	23.24	22.67	.45	.53	12.36	.50	2.60
830	Fresno	1888	23.16	24.11	.34	.60	11.55	.58	2.10
114	San Gabriel	1884	------	------	------	------	11.42	.40	2.16
261	San Gabriel	1884	19.19	19.15	.54	.31	10.50	.60	2.05
348	Vina	1885	23.35	------	.39	.60	12.00	.68	2.69
471	Vina	1886	22.50	------	.50	.48	10.25	.75	1.80
362	Lower Lake	1885	22.69	------	.47	.40	11.00	.54	1.68
349	Harrisburg	1885	19.46	------	.80	.30	10.16	.65	1.93
366	Patchen	1885	12.62	------	.75	.32	6.00	.48	1.52
572	Sacramento	1886	24.00	24.33	.39	.39	------	------	------
508	Livermore	1886	20.80	20.24	.44	.37	9.90	.40	2.05
692	Livermore	1887	22.87	22 67	.62	.42	11.18	.50	2.30
501	Cupertino	1886	13.10	11.68	1.02	.09	5.00	.79	1.30
748	Cupertino. (Long-pruned)	1887	19.40	19.21	.65	.33	9.90	.54	2.10
754	Cupertino. (Short-pruned)	1887	21.98	21.63	.81	.37	11.45	.66	2.30
940	Cupertino. (Short-pruned)	1888	19.13	19.75	.31	.39	9.54	.55	1.40
941	Cupertino. (Long-pruned)	1888	19.30	19.54	.63	.45			
1165	Cupertino	1889	20.10	------	.63	------	------	------	------
1279	Cupertino	1890	19.30	------	.87	------	------	------	------
2085	Cupertino	1893	17.20	------	.99	------	------	------	------
1173	Mission San José	1889	21.20	21.55	.47	.32	10.42	.43	2.35
1383	Mission San José	1890	20.20	------	.68	.34	11.45	.50	2.44
1565	Mission San José	1891	20.60	------	.68	------	10.91	.62	2.32
1773	Mission San José	1892	20.70	19.21	.79	------	11.00	.55	2.20
2061	Mission San José	1893	22.60	21.63	.79	.23	11.64	.71	2.15
2241	Mission San José	1894	18.80	------	.69	------	------	------	------
1449	Tulare	1891	21.50	------	.53	------	------	------	------
1667	Tulare	1892	19.60	------	.56	.36	9.73	.51	2.35
1908	Tulare	1893	20.00	19.21	.75	.44	9.70	.45	2.60
2333	Tulare	1894	21.90	20.10	.55	------	10.17	.39	2.45
1539	Paso Robles	1891	23.70	------	.45	------	------	------	------
1644	Paso Robles	1892	19.05	------	.80	------	------	------	------
2008	Paso Robles	1893	22.05	21.40	.45	.39	11.00	.45	2.30
2217	Paso Robles	1894	22.80	------	.68	------	------	------	------
1660	Amador station	1892	21.10	------	.60	------	------	------	------
1839	Amador station	1893	15.20	------	.91	------	------	------	------
1861	Amador station	1893	17.70	------	.90	------	------	------	------
2190	Amador station	1894	24.35	------	.38	------	------	------	------
2315	Amador station	1894	25.40	------	.41	------	------	------	------
	Average, Presno	------	**22.48**	**22.24**	**.41**	**.52**	**11.41**	**.32**	**2.32**
	Average, Livermore	------	**21.83**	**21.45**	**.52**	**.39**	**10.54**	**.45**	**2.17**
	Average, Cupertino	------	**19.48**	**20.03**	**.69**	**.38**	**10.29**	**.58**	**1 93**
	Average, Mission San Jose	------	**20.70**	**20.79**	**.68**	**.29**	**11.08**	**.56**	**2.29**
	Average, Tulare	------	**20.75**	**19.65**	**.59**	**.40**	**9.85**	**.45**	**2.46**
	Average, Paso Robles	------	**21.90**	**21.40**	**.57**	**.39**	**11.00**	**.45**	**2.30**
	Average, Amador station	------	**20.75**	------	**.65**	------	------	------	------

AUSTRIAN AND HUNGARIAN TYPE—WHITE.

Throughout the vine-growing parts of Austria and Hungary, large quantities of light white wines are made, which are much appreciated for local consumption. The principal grapes used for this purpose are the Rother Steinschiller and the Slankamenka, for the mildest and lightest wines. These grapes average about 20% of sugar with 0.50% of acid. In California they show similar character, though the Slankamenka attains more sugar as a rule. Better, but still light and neutral wines are made from Wälschriesling, Velteliner, Rothgipfler, and Peverella. These are all promising for California, and are worthy of more extended trial. The finest wines of Austro-Hungary are made, generally, from the same grapes as those of Germany. The higher class of white grapes of France have also been introduced, and are cultivated with success. The Furmint or Gelber Mosler is extensively grown. In most places it makes a white wine of good medium quality; but in favored locations, such as that of Tokay, it makes wines of world-wide reputation.

The importance of testing the vines of this type will be realized when it is remembered that the production of wine in Austro-Hungary is second only to that in France, and for awhile exceeded it, after the advent of the phylloxera.

WÄLSCHRIESLING.

Description.—Vine small and not very vigorous; canes smooth, slender, with small and rather close joints; leaves five-lobed, of medium size, with well-marked and more or less deep sinuses, long, acute teeth, upper sinuses closed, the rest open, young leaves woolly, becoming glabrous; bunches small, conico-cylindrical, very slightly shouldered, sometimes double, rather close, on long, occasionally branched peduncles; berries small, round, juicy, with tender skin, varying in color from green to golden. The grapes ripen about the same time as the Johannisberg Riesling.

The Wälschriesling is said to have come originally from the Champagne district of France, and spread through southern Germany to Austria. What its name was (or is) in its original habitat has not been determined; its fruit resembles somewhat that of the Chardonay, but its leaves are very distinct. At present it is grown extensively in eastern Switzerland, Styria, and parts of lower Austria and Hungary. It succeeds best on warm, loose hillsides where the soil is fairly rich. In Austria it has the reputation of being the steadiest and heaviest bearer of any grapes capable of producing a good white wine. It has thus far not shown itself remarkable in this respect in California, but it is doubtful if it has yet been planted in the most suitable situations. It gives a wine of neutral character, resembling that of the true Riesling, except in its lack of special aroma. It is excellent for blending, and might advantageously be planted in association with the Johannisberg Riesling to offset the small bearing of the latter.

Analyses of Musts and Wines.

WÄLSCHRIESLING.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body
						By Weight	By Volume.		
1889—No. 1158. Cupertino	Oct. 9	23.50	23.13	.36	.29	10.81	13.27	.36	1.85
1890—No. 1240. Margherita Vineyard, Fresno	Aug. 23	26.90	27.13	.39	.40	11.15	13.64	.50	2.08
No. 1309. Mission San José	Oct. 5	21.70	......	.57	.27	8.91	11.09	.34	1.90
1891—No. 1550. Paso Robles	Oct. 6	26.35	......	.40	...	......	......	......	......
1892—No. 1741. Paso Robles	Oct. 11	25.20	......	.43	...	......	......	......	......
1893—No. 1806. Amador station	Sept. 1	20.00	......	.86	...	......	......	......	......
No. 1886. Paso Robles	Sept. 19	26.00	......	.45	...	......	......	......	......
No. 1915. Paso Robles	Oct. 5	26.70	26.31	.41	.40	10.81	13.27	.30	2.30
No. 2028. Cupertino	Oct. 31	23.70	......	.75	...	......	......	......	......
1894—No. 2142. Amador station	Sept. 13	27.20	......	.44	...	......	......	......	......

Record of Treatment.

No. 1158. *Wälschriesling*, from J. T. Doyle, Cupertino. The grapes arrived October 10, 1889, in good condition, and were crushed the same day, the juice showing 23.50% of solid contents. The bunches were small, cylindrical, and close, with a distinct wing attached to nearly every one; grapes small and round, skin thin and tender, yellowish-green in color, with a brown spot at the end of each grape; flesh soft and juicy, sweet, and without special flavor; it corresponded exactly with Goethe's description, except that the bunches were very small. Fermentation commenced October 11th at 77°, and reached its maximum on October 13th at 81°. On October 17th the wine was dry. From 103.5 lbs. were obtained 7.31 gals., corresponding to 141.4 gals. per ton; pomace, 22.7%; stems, 5.8%.

In seven weeks after crushing the wine was bright, with a very light color, very strong bouquet, agreeable flavor, clean and developed taste; its acid, body, and alcohol were adequate, and quality good. A week later it was racked and taken to the cellar. At fourteen weeks it was still bright, but the bouquet had diminished somewhat; quality was good, but its taste still raw; lees sound. At six and one half months it was racked again. At eight months the wine was bright, with a marked bouquet, an agreeable flavor, but somewhat spoiled by slight taste of mold; quality good.

No. 1240. *Wälschriesling*, from Margherita Vineyard, Fresno. Received August 26, 1890, in good condition, and mature. The bunches were small, conico-cylindrical, very slightly shouldered, sometimes double, rather close; the berries were small, round, soft, and juicy, with tender skin, varying in color from green to golden. The must showed 26.9% of solid contents by spindle. The fermentation attained its maximum temperature of 81° on the third day, and after that continued slowly for over a month.

At the end of a month the wine was still cloudy and fermenting, and was racked for the second time. At the end of ten weeks it showed some good qualities, but had a suspicious taste. The lees showed a few lactic ferments. A month later the lactic taint was beginning to be noticeable to the taste, and the wine was pasteurized. At the end of nine months it was bright, but not clean-tasting. After this it changed very little, and was racked three times before it was bottled at seventeen months.

No. 1309. *Wälschriesling*, from J. T. Doyle, Cupertino. Received October 8, 1890, in bad condition, many of the grapes moldy. The must showed 21.7% of solid contents by spindle. The fermentation was cool, and lasted nine days; the maximum temperature reached was 73°, on the fourth day.

The wine was racked three times during the first four months, but was somewhat slow in clearing. At five months the lees showed some lactic ferments and the odor was slightly affected, so the wine was pasteurized. Two months later the wine was clear and free from lactic taste; it had a pleasing flavor and some bouquet. At fifteen months it was bright and much improved, with good flavor, some bouquet, and good body. At seventeen months it was mature, and was racked for the fifth time, and some of it bottled. The rest was bottled at twenty-three months. At three years both bottlings were in excellent condition, not highly flavored, but good wines; the last bottled was the brighter and cleaner-tasting.

No. 1550. *Wälschriesling*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition, and mature; the bunches were small and compact. The must showed 26.35% of solid contents by spindle.

No. 1741. *Wälschriesling*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 25.2% of solid contents by spindle.

No. 1806. *Wälschriesling*, from Amador station. A sample for must analysis arrived September 1, 1893, in good condition. The bunches were small and compact, the berries small. The grapes were not quite mature. The must showed 20.0% of solid contents by spindle.

No. 1886. *Wälschriesling*, from Paso Robles station. This sample was received September 21, 1893, under the name of Blue Portuguese, but appeared to be identical with Wälschriesling. The grapes were in good condition, and the must showed 26.0% of solid contents by spindle.

No. 1915. *Wälschriesling*, from Paso Robles station. Received October 7, 1893, in good condition. The bunches were small, cylindrical, very compact, sometimes with a small wing; the berries small, round, thin-skinned, and juicy. The grapes were quite mature and commencing to shrivel. The must showed 26.7% of solid contents by spindle. The fermentation lasted nine days, and reached its maximum temperature of 78° on the second day.

At one month the wine was clear and clean-tasting, without any special flavor. At three months it had been racked three times, and was bright, heavy-bodied, without much character, and lacking in freshness. At seven months it showed little change, and was lacking in acid.

No. 2028. *Wälschriesling*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 31, 1893, in good condition. The bunches were of medium size, very irregular, branching, and well filled; the berries small, juicy, without special flavor, mature. The must showed 23.7% of solid contents by spindle.

GRÜNER VELTELINER.

Synonyms: Valtelliner; Valtellin; Veltliner; St. Valentin; Weissgipfler.

Description.—Vine vigorous, with medium-sized, rather short-jointed canes; leaves of medium size or larger, generally rather deeply five-lobed, but occasionally almost without sinuses, dark-green and glabrous above, loose-woolly below, teeth sharp and unequal; bunches of medium size or larger, conico-cylindrical, winged, close, but not compacted; berries small to medium, nearly round or slightly ovoid, juicy, thick-skinned, without special flavor, and late in ripening.

The Red Velteliner seems to have come originally from the province of Valtellina, in upper Italy, where it is still widely cultivated, being adapted to high altitudes. It is now widely spread over Austria and parts of Germany, and is considered a valuable grape.

The Grüner Velteliner, which differs materially from the other Veltelіners, and in botanical characters approaches more nearly to the Rothgipfler, is not so widespread, but is common in lower Austria. The latter grape, which is the only one planted at the stations, has done well wherever tried. It is rather late in ripening, but has always developed a full amount of sugar, together with an adequate acidity. This is true even at Fresno, where the must has averaged 0.51% of acid with 26.3% of sugar. The average must composition, for six years, of grapes of this variety grown at Cupertino and at Mission San José has been 25.1% of sugar and 0.52% of acid. The wine is neutral in character, and requires the addition of some more aromatic grape for the production of a fine white wine. The vine bears well with short-pruning.

ANALYSES OF MUSTS AND WINES.

GRÜNER VELTELINER.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body
1889—No. 1108. J. T. Doyle, Cupertino	Sept. 26	25.60	25.76	.46	.40	10.35	12.82	.48	2.55
1890—No. 1208. Margherita Vineyard, Fresno	Aug. 12	23.30	22.23	.53	.40	9.20	11.45	.32	1.80
No. 1306. J. T. Doyle, Cupertino	Oct. 7	25.90	------	.54	.33	------	------	------	------
No. 1346. J. Gallegos, Mission San José	Oct. 11	25.20	------	.51	.30	11.23	13.73	.47	2.58
1891—No. 1454. Fresno	Aug. 28	26.60	------	.48	----	10.35	12.82	.44	2.95
No. 1605. Mission San José	Oct. 25	23.50	24.12	.53	----	9.63	12.00	.40	2.15
1892—No. 1784. Mission San José	Oct. 20	24.25	------	.55	----	------	------	------	------
1893—No. 1803. Amador station	Aug. 29	19.30	------	.87	----	------	------	------	------
No. 1989. J. Gallegos, Mission San José	Oct. 19	24.80	23.61	.60	----	10.63	13.09	.57	2.30
No. 2101. J. T. Doyle, Cupertino	Nov. 6	28.00	------	.51	----	------	------	------	------
1894—No. 2252. Mission San José	Oct. 5	23.50	------	.49	----	------	------	------	------

RECORD OF TREATMENT.

No. 1108. *Grüner Velteliner*, from J. T. Doyle, Cupertino. This variety arrived in poor condition September 27, 1889, and was crushed the same day; the juice showed 25.6% of solid contents. The grapes resemble very much the Marsanne, both in bunches and leaves. Bunches branched and rather large, generally loose; grapes medium size and very slightly oval, varying in color from green to golden-yellow. Fermentation commenced September 28th, reached its maximum September 30th at 83.5°, and continued gently till October 5th, when the wine was dry. From 122 lbs. crushed, 8.62 gals. were obtained, corresponding to 141.6 gals. per ton.

At six weeks the wine was clear, with a light greenish-golden color, agreeable bouquet, clean, and fairly developed taste; acid and body adequate; general quality, very good. At two months it was racked and taken to the cellar. Seven weeks later the wine was clear, and its general effect very pleasant; bouquet not much developed, but agreeable; lees sound. In seven weeks it was racked again, and a month later the lees were found to be sound. At nine months from crushing the wine was bright, of a light, pleasing bouquet, and full, rich flavor, rather rough taste, full body and alcohol; quality good. At fifteen months the lees showed much *S. pastorianus* ferment. The wine was bright and with a delicate bouquet; as a whole, it was of very good quality and well matured at date. In a month it was bottled, and at seventeen months from crushing the wine was very good, but lacked in bouquet.

No. 1208. *Grüner Velteliner*, from Margherita Vineyard, Fresno. Received August 15, 1890, in good condition, and mature. The bunches were large to medium in size, very irregular in shape, generally conico-cylindrical, well shouldered or winged, often double, and varying from loose to well filled, but the berries never compressed; the berries were below average size, slightly oval, on long and slender pedicels; the flesh was crisp, juicy, and sweet, but without marked flavor. The must showed 23.3% of solid contents by spindle. The fermentation was cool and prolonged. The maximum temperature of 78° was reached on the fourth day, and the must continued to ferment slowly for about ten days.

At five weeks the wine was nearly clear, and was racked for the second time. At three months it had a pleasant flavor and a little bouquet, soft acid; quality in general fair, but the after-taste not good. At six months the wine had been racked three times; it was clear and of good flavor, and possessed a little bouquet; the lees showed some lactic germs, but the taste was unaffected; it was pasteurized for safety. At nine months it was bright and pleasing, but a little flat. At sixteen months it was bright and mature, and had been racked four times. At eighteen months it was bottled. Two years after bottling the wine was tasted and found to be bright, clean-tasting, and well matured, with little bouquet or flavor, but sound and drinkable.

No. 1306. *Grüner Velteliner*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 8, 1890, in fair condition. The must showed 25.9% of solid contents by spindle.

No. 1346. *Grüner Veltеliner*, from Mission San José. Received October 14, 1890, in fair condition, with some rotten and moldy bunches. The must showed 25.2% of solid contents by spindle. The fermentation lasted eight days, and reached its maximum temperature of 77° on the third day.

At three weeks after crushing the wine was still cloudy and a little sweet. At seven weeks it was bright, very agreeably flavored, with medium acid and good body. At three months it had been racked twice, and was bright and sound, with a delicate bouquet, but a slightly smoky after-taste. It went on improving and maturing, and remained bright until the ninth month, when the lees showed a few lactic ferments, without the taste, however, being affected. At fourteen months it was clear, of good flavor, and with a little bouquet, but also with a faint suspicion of lactic taint in the after-taste. It was bottled two months later. At two years after bottling the wine was light, smooth, with good bouquet, but not quite clear or clean-tasting.

No. 1454. *Grüner Veltеliner*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition, and mature. The must showed 26.6% of solid contents by spindle. The fermentation reached its maximum temperature of 78° on the third day, and continued slowly for over two weeks.

At six weeks the wine was clear and dry, of good body and fairly agreeable, but with a somewhat doubtful after-taste. At four months the wine had been racked twice, and the lees showed a few long filaments; it was clear and of good bouquet and flavor, but the after-taste was not perfectly clean. It was racked twice more during the first year, and remained bright and matured well. At sixteen months it was bright, sound, and full-bodied. A month later it was bottled.

No. 1605. *Grüner Veltеliner*, from Mission San José. Received October 28, 1891, in poor condition. The must showed 23.5% of solid contents by spindle. The fermentation lasted eight days, and reached its maximum temperature of 80° on the fourth day.

A month from crushing the wine was not quite clear, but full-flavored, smooth, and agreeable. At three months it was clear and very pleasing, but not quite clean-tasting. At six months it was clear and sound, but still raw. At eight months it had improved much, was bright, smooth, and aromatic, of good body and advanced development. At eleven months it was racked for the third time. At fifteen months it was in good condition and nearly mature. A month later it was bottled.

No. 1784. *Grüner Veltеliner*, from Mission San José. Received October 21, 1892, in poor condition. The must showed 24.25% of solid contents by spindle. The grapes were fermented with No. 1783, Steinschiller.

No. 1803. *Grüner Veltеliner*, from Amador station. A sample for must analysis arrived September 1, 1893, in good condition. The bunches were of medium size, the berries small. The must showed 19.3% of solid contents by spindle.

No. 1989. *Grüner Veltеliner*, from Mission San José. Received October 19, 1893, in good condition. The bunches were from small to medium, conico-cylindrical, with a large or small wing, close, but not compacted, on slender peduncles; the berries were small, round, on very slender pedicels, soft, juicy, thin-skinned, without distinctive flavor. The grapes were quite mature. The must showed 24.8% of solid contents by spindle. The fermentation lasted six days, and reached its maximum temperature of 78° on the third day.

The wine continued fermenting gently for over a month, and was not quite clear or dry six weeks after crushing. At three months it was bright, of good bouquet and flavor, very fresh and clean-tasting, but without marked character. At seven months it had been racked three times, and tasted very smooth and agreeable.

No. 2101. *Grüner Veltеliner*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The bunches were under medium size, conical, well filled, but not compact; the berries small, slightly elongated, juicy, thick-skinned, mature.

ROTHGIPFLER.

Synonym: Reifler.

Description.—Vine of medium size, hardy (and in Europe said to be very prolific); leaves of medium size, round, five-lobed, with somewhat shallow, open sinuses, teeth small; bunches of medium size, roundish, compact; berries small, round, juicy, with rather tough skin, and very much punctate. The grapes ripen rather late, and are of neutral flavor.

The Rothgipfler is a grape of lower Austria, where it is rather extensively planted, and whence it has spread into Bavaria and Würtemburg. It is prized in the vineyards of these countries, on account of its hardiness against extreme cold and heat, its fruitfulness, and the quality of its wines.

In California it has not maintained its reputation, especially in regard to its bearing qualities. The vine has been planted in Cupertino, Mission San José, Amador, and Paso Robles, but only once has produced enough for a wine-making test. The wine made showed more character than that of the Grüner Velteliner, but the must is in general lower in acidity.

ANALYSES OF MUSTS AND WINES.

ROTHGIPFLER.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body
						By Weight	By Volume		
1889—No. 1105. J. T. Doyle, Cupertino	Sept. 26	28.20	28.07	.46	.34	11.46	14.00	.39	2.20
1890—No. 1359. J. T. Doyle, Cupertino	Oct. 11	28.00	------	.46	---	------	------	------	----
1891—No. 1530. Paso Robles	Oct. 6	26.50	------	.34	---	------	------	------	----
1892—No. 1722. Paso Robles	Oct. 10	25.20	------	.41	---	------	------	------	----
1893—No. 1800. Amador station	Sept. 1	21.10	------	.87	---	------	------	------	----
1894—No. 2143. Amador station	Sept. 13	28.90	------	.35	---	------	------	------	----
No. 2238. Mission San José	Oct. 5	22.60	------	.49	---	------	------	------	----

RECORD OF TREATMENT.

No. 1105. *Rothgipfler*, from J. T. Doyle, Cupertino. Grapes arrived September 27, 1889, and were crushed the same day. The juice showed 28.2% of solid contents by spindle. The condition of the grapes was rather good, but they had commenced to dry up a little. They corresponded to Pulliat's description, but the bunches were somewhat more elongated. Fermentation commenced September 28th at 72.5°, and reached its maximum September 29th at 82°. On the seventh day the wine was dry and had fallen to the cellar temperature (72°). From 46.5 lbs. crushed were obtained 3.87 gals., corresponding to 167 gals. per ton; pomace, 30.6%; stems, 3.8%.

At six weeks from crushing the wine was clear, the color light-green, bouquet pleasant, but a little woody; flavor fruity, but tasting slightly of the wood; general quality good and advanced. At two months it was racked and taken to the cellar. At fifteen weeks the wine was in good order and of agreeable flavor and bouquet, but still had the woody taste; lees sound. Two months later it was racked into a one-gallon keg, and after six weeks the lees were found to be sound. At nine months from crushing the condition of the wine was bright, the bouquet and flavor both full and, but for a taste of cask, very agreeable; well developed, with good alcohol and body; general quality good.

No. 1359. *Rothgipfler*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in good condition. The bunches were small, cylindrical, close, on short and slender peduncles; the berries small, regular, somewhat oval, on short and slender pedicels; the skin thick, tough, yellowish-green, much spotted; the flesh firm and sweet. The must showed 28.0% of solid contents by spindle.

No. 1530. *Rothgipfler*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition. The bunches were small and compact, with round-ovoid berries. The grapes were mature, and the must showed 26.5% of solid contents by spindle.

No. 1722. *Rothgipfler*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 25.2% of solid contents by spindle.

No. 1800. *Rothgipfler*, from Amador station. A sample for must analysis arrived September 4, 1893, in good condition, but not quite mature. The bunches were of medium size, compact, with small berries. The must showed 21.1% of solid contents by spindle.

PEVERELLA.

Synonym: Pfeffertraube.

Description.—Vine very vigorous; leaves of medium size, not very deeply lobed, smooth above, loose-woolly below; bunches large, conico-cylindrical, compact, on thick peduncles; berries of medium size, nearly round, juicy, tough-skinned, of greenish color. The vines do well in moist soils, but only in warm localities. The grapes ripen late, but in suitable localities attain a high percentage of sugar with good acid.

The Peverella is cultivated principally in southern Tyrol and Venetia. It is said to give there a good, alcoholic wine of fair aroma. At the Experiment Stations it has shown itself a vigorous grower and good bearer. The must has always had good to high acid, but occasionally fails to develop enough sugar in the cooler localities. The wine made has been neutral in character, smooth and agreeable, but evidently needs blending with a variety of higher quality.

Analyses of Musts and Wines.

PEVERELLA.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body
1889—No. 1190. J. T. Doyle, Cupertino	Oct. 17	20.40	------	.50	.22	7.78	9.73	.36	1.55
1890—No. 1406. J. T. Doyle, Cupertino	Oct. 20	23.05	------	.87	.27	9.70	12.09	.57	2.32
No. 1426. J. Gallegos, Mission San José	Oct. 28	29.10	------	.92	----	------	------	------	----
1891—No. 1463. Fresno	Aug. 28	23.92	22.67	.74	.43	9.41	11.73	.48	2.25
No. 1602. Cupertino	Oct. 23	20.85	20.24	.67	.30	8.70	10.83	.52	2.05
1892—No. 1743. Paso Robles	Oct. 11	24.35	------	.41	----	------	------	------	----
No. 1782. Mission San José	Oct. 18	23.15	------	.80	----	------	------	------	----
1893—No. 1836. Amador station	Sept. 5	22.60	------	.89	----	------	------	------	----
No. 1941. Tulare	Oct. 10	24.40	------	.50	----	------	------	------	----
No. 2015. Mission San José	Oct. 25	23.10	21.22	.94	.23	9.70	12.09	.67	2.80
1894—No. 2191. Amador station	Sept. 25	26.90	------	.51	----	------	------	------	----
No. 2300. Mission San José	Oct. 12	19.75	------	.67	----	------	------	------	----
No. 2330. Tulare	Oct. 15	26.90	------	.38	----	------	------	------	----

Record of Treatment.

No. 1190. *Peverella*, from J. T. Doyle, Cupertino. Grapes arrived October 18, 1889, in good condition, and were crushed the same day. The bunches were medium in size, cylindrical, winged, rather loose; grapes were small, round, or sometimes very slightly longer than their width; skin not thick, but rather tough; color from green to golden, with a light bloom; flesh soft and juicy; flavor acid; stems thick; pedicels long and slender; maturity complete. The juice showed 20.40% of solid contents by spindle. Fermentation of 113½ lbs. crushed began on October 19th at a temperature of 68° (room, 72°), and reached its maximum the following day at a temperature of 76°, and remained at the same temperature during twenty-four hours, when the murk was drawn off. The yield from the above amount was 9$\frac{3}{16}$ gals., corresponding to 161.89 gals. per ton; pomace, 19.6%, and stems, 5.06%.

At one month the wine was nearly clear, and was racked. At three months it was still nearly clear; bouquet and flavor not marked; taste rather flat; acid adequate; quality raw, but may mature-out well. At six months the lees were sound; a not quite bright wine, but tastes sound; racked again. At eight months the wine was bright, very light amber in color, with a peculiar, smoky bouquet and flavor; taste clean; body and acid rather low. Quality thin, but not bad.

No. 1406. *Peverella*, from J. T. Doyle, Cupertino. Received October 23, 1890, in good condition; fine, large, well-filled bunches of under-average sized, round grapes, mature. The must showed 23.05% of solid contents by spindle. The fermentation lasted eight days, and reached its maximum temperature of 84° on the third day.

At one month the wine showed good quality, was nearly clear, and had a good flavor, some aroma, medium acid, and good body. At two months it was racked for the second time, and a month later the lees showed a few lactic rods, so the wine was pasteurized. The taste had not become affected by the lactic ferment. At seven months the wine was bright and much improved, of full, delicate bouquet and flavor. It was racked twice after this, but the quality deteriorated. Some of it was bottled at eighteen and some at twenty-six months, but it did not keep well in bottle.

No. 1426. *Peverella*, from Mission San José. A sample for must analysis arrived October 31, 1890, in poor condition, overripe. The must showed 29.1% of solid contents by spindle.

No. 1463. *Peverella*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition, but not quite mature. The must showed 23.92% of solid contents by spindle. The fermentation was slow and cool. The maximum temperature of 75° was reached on the second day, and the murk remained at this temperature for two days, after which it continued fermenting slowly at about the temperature of the room (71° to 74°) for a month.

At the end of six weeks the wine was nearly clear and quite dry. At ten weeks it was bright, and showed good flavor and aroma. At the end of five months it had been racked twice, and was bright and clean-tasting. It remained sound and became smoother, but developed little bouquet. It was racked four times during the first year. At sixteen months it was in good condition, very smooth and agreeable, and quite mature. A few days after this it was bottled.

No. 1602. *Peverella*, from J. T. Doyle, Cupertino. Received October 24, 1891, in good condition. The must showed 20.85% of solid contents by spindle. The fermentation was slow and cool, lasting ten days. Five weeks from crushing the wine was racked for the second time, and blended with No. 1601, White Vernaccia.

No. 1743. *Peverella*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 24.35% of solid contents by spindle.

No. 1782. *Peverella*, from Mission San José. A sample for must analysis was received October 21, 1892, in poor condition. The must showed 23.15% of solid contents by spindle.

No. 1836. *Peverella*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition. The bunches were of good size, long-cylindrical, fairly compact; the berries small, not mature. The must showed 22.6% of solid contents by spindle.

No. 1941. *Peverella*, from Tulare station. A sample for must analysis was received October 13, 1893, in good condition, but a little sunburned. The bunches were small, compact, irregularly conico-cylindrical; the berries over medium in size, with thick, tough skin, and without flavor. The must showed 24.4% of solid contents by spindle.

No. 2015. *Peverella*, from Mission San José. Received October 25, 1893, in good condition. The bunches were over medium in size, close, conico-cylindrical, slightly shouldered or with one small wing; the berries of medium size, nearly round, juicy, thick-skinned, not quite mature. The must showed 23.1% of solid contents by spindle. It was fermented with No. 2014, White Vernaccia.

VERNACCIA BIANCA.

Synonyms: Vernazza; Weiss-Vernatsch.

Description.—Vine vigorous; leaves of medium size, dark green, smooth above, a little woolly below, deeply lobed, and with acute teeth; bunches of medium size, conico-cylindrical, somewhat compact, generally without shoulders; berries small, firm, juicy, and nearly round, greenish-white; seeds free from the pulp, sharp, and incurved.

The name Vernaccia is given to several distinct grapes in Italy, but the one described above is that which forms the bulk of the white-wine vineyards of northern and southern Tyrol. It is also grown in Lombardy and the province of Pavia. It bears well with moderately short-pruning, and is especially adapted to low and damp situations, on account of its tardiness in coming out in the spring. It ripens its grapes a little earlier than the Peverella, and attains rather a higher percentage of sugar. It is noted for retaining a good amount of acid, even with high sugar-contents, but at the Tulare station it has failed to confirm its reputation in this respect.

In suitable locations it gives a full-bodied, alcoholic wine, of good quality, but with less aroma than the best Rhine-wine varieties. It will doubtless prove an excellent variety in warm localities, for damp valley lands subject to early frosts, in association with the Peverella, with which it makes a very good blend.

ANALYSES OF MUSTS AND WINES.

VERNACCIA BIANCA.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body
						By Weight	By Volume		
1889—No. 1091. J. Gallegos, Mission San José	Sept. 17	24.36	24.64	.66	.37	------	------	------	------
No. 1148. J. T. Doyle, Cupertino	Oct. 8	23.15	21.80	.55	.31	9.70	12.09	.40	2.45
1890—No. 1236. Margherita Vineyard, Fresno	Aug. 22	23.40	23.13	.53	.33	------	------	------	------
No. 1400. J. T. Doyle, Cupertino	Oct. 18	25.90	------	.68	----	------	------	------	------
No. 1422. J. Gallegos, Mission San José	Oct. 28	28.60	------	.66	----	------	------	------	------
1891—No. 1549. Paso Robles	Oct. 6	22.60	21.80	.32	----	------	------	------	------
No. 1601. Cupertino	Oct. 26	23.70	23.61	.81	.33	------	------	------	------
1892—No. 1723. Paso Robles	Oct. 10	25.45	------	.36	----	------	------	------	------
No. 1781. Mission San José	Oct. 18	24.80	------	.65	----	9.92	12.36	.73	2.70
1893—No. 2014. Mission San José	Oct. 24	24.80	23.80	.84	.32	------	------	------	------
No. 2104. Cupertino	Nov. 4	24.80	------	1.07	----	------	------	------	------
1894—No. 2188. Amador station	Sept. 23	24.70	------	.38	----	------	------	------	------
No. 2305. Mission San José	Oct. 10	22.20	------	.51	----	------	------	------	------
No. 2328. Tulare	Oct. 13	23.30	------	.32	----	------	------	------	------

RECORD OF TREATMENT.

No. 1091. *Vernaccia bianca.* From J. Gallegos, Mission San José. The grapes arrived September 19, 1889, consisting of only a few bunches for must analysis. Their maturity was irregular. They corresponded to Pulliat's description, except that none of the bunches had wings. The juice showed 24.36% of solid contents by spindle.

No. 1148. *Vernaccia bianca*, from J. T. Doyle, Cupertino. The grapes arrived October 9, 1889, and were crushed the same day. The bunches were irregular, some cylindrical, some conical and branched, not compact. The grapes were slightly oval, medium size; skin green, thick, rather tough; flesh very soft and juicy; flavor quite spoilt by overripeness and rain. The grapes had commenced to rot. The juice showed 23.15% of solid contents by spindle. Fermentation of 118¼ lbs. crushed started on the afternoon of October 10th at 69° (room, 72°), and reached its maximum of 77.5° on October 12th (room, 72°), gradually falling to 70° on October 17th, when the wine was dry, and was put in keg.

The yield from the above amount was 7⅛ gals. of wine, corresponding to 131.2 gals. per ton; pomace, 28.5%, and stems, 3.8%.

Twenty-one days after crushing the wine was clear, the bouquet developing, the flavor agreeable and smooth, the taste clean, the acid normal, and the alcoholic strength high; the general quality was good and well developed for its age. In five days it was racked and taken to the cellar. At eighty days the wine was still clear, with a delicate and pleasing bouquet and flavor, much developed since last tasting; lees sound. At six months it was racked again. Eight months after crushing, it was bright, bouquet perfumed, taste rather thin, but is otherwise of very good quality; acid and alcoholic strength adequate.

No. 1236. *Vernaccia bianca*, from Fresno. A sample for must analysis arrived August 25, 1890, in fair condition, and quite mature. The must showed 23.4% of solid contents by spindle and 0.53% of acid.

No. 1400. *Vernaccia bianca*, from Cupertino. A sample for must analysis was received October 21, 1890, in fair condition, and somewhat overripe. The must showed 25.9% of solid contents by spindle and 0.68% of acid.

No. 1422. *Vernaccia bianca*, from Mission San José. A sample for must analysis was received October 31, 1890. The must showed 28.6% of solid contents by spindle and 0.66% of acid.

No. 1549. *Vernaccia bianca*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition, and mature. The bunches were small, but well filled. The must showed 22.6% of solid contents by spindle and 0.32% of acid.

No. 1601. *Vernaccia bianca*, from Cupertino. Received October 24, 1891, in good condition. The must showed 23.7% of solid contents by spindle and 0.81% of acid. Only 30 lbs. of grapes were crushed, and the fermentation lasted eleven days, the highest temperature reached being 74°.

The wine was racked eleven days after crushing, and at one month was clear, with good but neutral flavor, and good acid. At six weeks it was racked again and blended with No. 1602, Peverella, in the proportion of one third Vernaccia to two thirds Peverella. At three months the wine was very clear, clean-tasting, with full acid and neutral flavor, and was racked again. The lees were examined microscopically at three and at four months, and found to be quite sound. At five months it was racked again, and was bright and fresh-tasting. At seven and eight months it showed little change, and was racked again. At fifteen months the wine was bright, smooth, and mature, with good flavor and a little bouquet; it was then bottled. After two years in bottle the wine had acquired a slight Sherry character; it was very smooth and agreeable, but without marked flavor or bouquet.

No. 1723. *Vernaccia bianca*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 25.45% of solid contents by spindle and 0.36% of acid.

No. 1781. *Vernaccia bianca*, from Mission San José. Received October 21, 1892, in fair condition. The must showed 24.8% of solid contents by spindle and 0.65% of acid. The grapes were fermented with No. 1782, Peverella, in the proportion of one fifth Vernaccia to four fifths Peverella. The highest temperature reached during fermentation was 77°.

In one month the wine was quite clear, and was racked. At three months it was bright, of full, rich flavor, some bouquet, high acid, and generally of good quality. Two months later it was in good condition, and was racked again. Tastings at eight, ten, and fourteen months showed steady maturing and gradual development of bouquet. At fifteen months the wine was still very good, but had become a little *éventé*. As the wine would evidently not improve further in so small a keg (five gallons), it was bottled. Two years after bottling the wine was very good; it was full-flavored, full-bodied, and with good acid. The bouquet was rather faint, but of good quality. Altogether, it was a very successful blend.

No. 2014. *Vernaccia bianca*, from Mission San José. Received October 26, 1893, in good condition. The bunches were small, conico-cylindrical, somewhat compact, not shouldered; berries small, round, juicy, with full acid. The seeds are quite characteristic, being quite free from the pulp, sharp, and incurved. The must showed 24.8% of solid contents by spindle and 0.84% of acid. The grapes were fermented with No. 2015, Peverella, in the proportion of nine sixteenths Vernaccia to seven sixteenths Peverella. The fermentation lasted nine days, reaching the maximum temperature of 76° on the third day. A parallel fermentation was made of the same quantity of each variety of grapes, with the addition of some German yeast. As no precautions were taken to exclude the ordinary yeast, the result was perfectly negative. There was apparently no difference in the course of fermentation or in the resulting wine of the two experiments, except that the must to which the yeast was added became dry a few days before the other, a result that is easily understood without predicating any peculiar properties of the German yeast.

No. 2014 (ordinary ferment). Two weeks after the first racking the wine was clear, but still a little sweet; it was racked again and taken to the cellar. At three months it was bright, clean-tasting, and with good flavor and aroma. At four months the wine had been racked three times, and was in very good order; a very agreeable wine, but without marked character. At eight months the wine was bright, clean-tasting, highly acid, but rather too neutral in flavor. The wine had no lees. At nineteen months it was mature, and was put in bottle. Six months after bottling the wine was perfectly bright, and had deposited no sediment. It was a smooth, good wine, much improved, and had developed a little bouquet. It tasted more mature than No. 2014*a*; in fact, a little flat.

No. 2014*a* (German ferment). Two weeks after the first racking the wine was clear and dry. At one month it was taken to the cellar. At three months it was bright, clean-tasting, with some aroma, and rather fresher-tasting than No. 2014. Several tastings after this showed little difference between the two samples, except that the wine which had been fermented with the ordinary ferments seemed to develop a little quicker. At fifteen months it was well developed, had good flavor, and had more bouquet than No. 2014. At nineteen months it tasted mature, and was bottled. Six months after bottling it was perfectly bright, and had developed no sediment. It was of distinctly higher bouquet than No. 2014, fresher-tasting, and generally better. The difference of character, which at first was scarcely noticeable, was at this time marked. The use of the German ferment seemed to have caused a slower maturity, but the development of higher quality.

FURMINT.

Synonyms: Gelber Mosler; Formint; Tokayer.

Description.—Vine vigorous, with thick, upright canes; leaves large thick, three-lobed, hairy below, teeth large and blunt, petiole thick, reddish, and somewhat hairy, young leaves white-woolly; bunches large, loose, long conico-cylindrical; berries of medium size, oval, on long, slender pedicels; flesh crisp, not juicy; skin from green to brown-yellow, and marked with brown dots and blotches.

This is the most valued and one of the most widely grown vines of Hungary and Austria. It is not found elsewhere, except to a limited extent in the south of France, where it was introduced from Hungary; and the name of Mosler is said not to be derived from the Moselle River, for it is not known in that district. It is valued on account of the high amount of sugar which it attains, and is used, especially in Styria, for mixing with thin, neutral grapes, such as the Heunish, to increase their alcoholic contents and quality. It is famous chiefly, outside of Austria, for making the celebrated sweet wines of Tokay. The vine is said to be a good bearer in its native country, but at the Experiment Stations it has produced very little. It has borne well and produced some good wine at Fresno. It ripens rather early, and requires medium-long pruning, and a warm location.

RECORD OF TREATMENT.

No. 2189. *Furmint*, from Amador station. A sample for must analysis was received September 24, 1894, in good condition. The bunches were large, loose, and badly coulured; the berries from large to small, ellipsoidal, on long, slender pedicels, which were not swollen at the junction with the berries; flesh crisp, not juicy; skin thin, from green to brown-yellow, conspicuously marked with brown spots and blotches; flavor not marked, but sweet. The must showed 23.15% of solid contents by spindle and 0.38% of acid.

ZIERFAHNDLER.

Description.—Vine strong and vigorous, with thick, dark-brown canes; leaves round, of medium size, five-lobed, with shallow sinuses, lobes overlapping, glabrous above, little downy below, teeth short and blunt; bunches small, cylindrical, with small shoulders, compact; berries small, round, soft, juicy, thin-skinned, sweet, but without special flavor.

The above description of this grape as grown in California does not agree altogether with that given of the Rother Zierfahndler of Austria by Goethe. Our grape has smaller bunches, more deeply colored berries, and ripens earlier. This variety is considered by some authors to be simply a pink-fruited form of the Franken Riesling, with which it has great similarity in leaf characters. It is a strong grower, and bears fairly well; its wine has rather more character than that of the Franken Riesling, but is far from possessing the strong aroma of the Traminer. In the warmer parts of California it fails to color well or to develop its aroma. It is rather later than the Ruländer, but if left long enough on the vines it attains almost an equal amount of sugar, with rather higher acid. It bears, in the districts suited to it (that is, the cooler coast counties), with short-pruning. The Zierfahndler is said in Austria to attain the highest percentage of sugar of any grape and to make an extremely fiery, alcoholic wine, which retains part of the sugar unfermented, and is very much appreciated as a dessert wine.

Analyses of Musts and Wines.

ZIERFAHNDLER.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body
1889—No. 1133. J. T. Doyle, Cupertino	Oct. 2	23.30	23.13	.47	.33	9.05	11.27	.44	2.35
1890—No. 1314. J. Gallegos, Mission San José	Oct. 7	26.50	------	.41	.40	10.81	13.27	.50	----
No. 1323. J. T. Doyle, Cupertino	Oct. 11	24.35	------	.75	----	------	------	------	----
1891—No. 1577. Mission San José	Oct. 13	27.35	-----	.33	----	11.32	13.75	.32	2.70
1892—No. 1760. Paso Robles	Oct. 11	18.15	------	.46	----	------	------	------	----
1893—No. 2090. J. T. Doyle, Cupertino	Nov. 5	24.80	------	.60	----	------	-----	------	----
1894—No. 2279. Amador station	Oct. 4	22.60	------	.42	----	------	------	------	----
No. 2280. Mission San José	Oct. 4	20.00	------	.53	----	------	------	------	----

Record of Treatment.

No. 1133. *Zierfahndler*, from J. T. Doyle, Cupertino. Received October 8, 1889, in good condition, and crushed the same day. The grapes were ripe, the bunches over average in size, some loose from coulure, but in general compact. The berries on loose bunches were rather large, quite round, and rose-colored; those on compact bunches were smaller and green, except where exposed to the sun; the skin was soft, but rather thick; the flesh sweet and juicy; the stems thick and the pedicels long. The temperature of the grapes at crushing was 71°, and the maximum reached was 77°, on the second day.

At two months the wine was nearly bright and had a slight schiller color, was of fair quality, but tasted of the wood; it was racked and taken to the cellar. Two months later it was bright and had lost some of its pinkish tinge, had developed some bouquet, and was generally much improved. An examination of the lees showed no unsound germs. At six months the wine was racked for the third time, and at seven months the lees were examined and found to contain some unsound germs. The wine was of good quality, well-flavored and full-bodied, but was somewhat affected by the secondary ferments. It was pasteurized, but did not improve; it remained flat and developed no bouquet.

No. 1314. *Zierfahndler*, from Mission San José. Received October 10, 1890, in somewhat bruised condition, but not moldy. The must showed 26.5% of solid contents by spindle. The fermentation was cool, and lasted six days.

At one month the wine had been racked twice, was clear, smooth, full-bodied, and with marked aroma. At three months the lees showed much lactic ferment, and the taste was affected; it was pasteurized, but remained cloudy for some time. At fourteen months it was clear and much improved, but still showed some lactic taste. At seventeen months it was racked. At twenty-seven months the bottled wine was bright, very smooth and soft, sound, but a little flat.

No. 1323. *Zierfahndler*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in fair condition. The must showed 24.35% of solid contents by spindle.

No. 1577. *Zierfahndler*, from Mission San José. Received October 16, 1891, in fair condition, and mature. The must showed 27.35% of solid contents by spindle. The must attained its maximum temperature of 80° on the third day, and fermented for five days, when it was nearly dry.

The wine was a little slow in clearing, and at one month the lees showed a little lactic ferment. At six weeks the wine was pasteurized. At five months the wine was good, but a little flat, full-bodied, low in acid, and with a remarkably high aroma. At seven months it had improved, and tasted quite sound. At ten months it was racked for the fourth time. At fifteen months it still retained its high flavor and full aroma, and had become smoother and cleaner-tasting. As it was in a small keg, it was bottled.

No. 1760. *Zierfahndler*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 18.15% of solid contents by spindle.

No. 2090. *Zierfahndler*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition; the bunches were under medium size, long-conical, and compact; the berries small, soft, juicy, very sweet, and mature. The must showed 24.8% of solid contents by spindle.

ROTHER STEINSCHILLER.

Synonyms: Rosentraube; Rother Verschetzer.

Description.—Vine very vigorous, with thick, short-jointed canes; leaves large, flat, little lobed, sharply toothed, the under side white-woolly; bunches of medium size, short, irregular, much branched, compact; berries under medium size, round, firm, from green to pink, according to position on the bunch, and becoming brownish with advanced maturity, skin very astringent, flavor neutral. The grapes ripen rather late and resist the action of the weather very well.

The Rother Steinschiller is cultivated extensively in parts of the Banat in southern Hungary, but is little known elsewhere. In cooler climates it will only ripen in the warmest exposure. In the Banat it bears large crops every year, with short-pruning. The Steinschiller vineyards produce large quantities of a mild, cheap wine, which is considered indispensable by the Austrian and Hungarian wine-merchants for blending purposes.

The Steinschiller has given results in California very similar to those reported from its native home. It bears well at all the stations where tried, and produces a neutral wine, low in alcohol, with medium acid, agreeable to drink, but without special flavor, and requiring the addition of some grape of more marked character. It is an extremely healthy vine, and is one of the best resisters of the *oidium* mildew.

ANALYSES OF MUSTS AND WINES.

STEINSCHILLER.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body
1889—No. 1174. J. Gallegos, Mission San José	Oct. 15	20.50	20.61	.33	.21	8.27	10.36	.57	2.32
No. 1201. J. T. Doyle, Cupertino	Oct. 23	19.30	18.89	.24	.23	7.85	9.82	.33	1.66
1890—No. 1415. J. T. Doyle, Cupertino	Oct. 27	20.60	......	.50	.29	8.91	11.09	.45	2.14
No. 1424. J. Gallegos, Mission San José	Oct. 28	23.70	......	.53	....	......	......	......	......
1892—No. 1783. Mission San José	Oct. 18	17.35	......	.73	....	......	8.46	.48	2.10
1893—No. 1996. Mission San José	Sept. 30	21.70	......	.73	....	......	......	......	......
No. 2016. Mission San José	Oct. 26	21.50	20.46	.55	.30	8.91	11.18	.68	2.60
No. 2068. Paso Robles	Nov. 1	21.50	20.99	.43	.27	14.02*	17.92*	.41	3.90
No. 2103. Cupertino	Nov. 2	21.20	......	.50	....	......	......	......	......

* Fortified.

RECORD OF TREATMENT.

No. 1174. *Steinschiller*, from Mission San José. Received October 16, 1889, in good condition, and mature. The bunches were of average size, conico-cylindrical, sometimes shouldered or winged, close; berries under medium size, round, light red, with thick bloom, thick but tender skin, firm and juicy flesh, flavor agreeable and sweet, but not marked; peduncles thick and woody, pedicels of medium length, and slender.

Only enough grapes were received to make one gallon of wine. It was of golden color, medium acid, very agreeable flavor, and in general a very promising wine, but owing to the smallness of the sample, it soon became acetified. The wine was kept for five months, then pasteurized; it developed some bouquet, and at seventeen months showed good quality, but was injured because of the smallness of the sample.

No. 1201. *Steinschiller*, from Cupertino. Received October 24, 1889, in good condition. Bunches of medium to over medium size, conical, heavily shouldered, generally compact; berries small, round, dark-rose colored, with thick but tender skin, rather soft and juicy flesh, agreeably flavored, but rough; maturity complete. The grapes had been exposed on the vines to many days of heavy rains, but were uninjured. The must showed 19.3% of solid contents by spindle and 0.24% of acid. The 70.5 lbs. of grapes received were made up into 5.5 gals. of white wine.

The wine was bright six weeks after pressing, of very light color, with little bouquet, and peculiar but not very agreeable flavor, low-bodied, and rather flat. It was racked and taken to the cellar, and six weeks later it was bright, improved in bouquet and flavor, but still rather insipid and watery-tasting. The wine was completely neutral in character, not disagreeable, but without any distinctive qualities. At six months the lees showed some bitter ferments, so the wine was pasteurized. One month later the wine was bright and tasted nearly mature, but was still insipid. After this it remained sound, and improved a little. At seventeen months it was bottled. It remained bright and sound in bottle, and at two years and a half it had improved and was of fair quality. Tasted a year later it had changed very little.

No. 1415. *Steinschiller*, from Cupertino. Received October 30, 1890, in good condition, and mature. The must showed 20.6% of solid contents by spindle and 0.50% of acid. The grapes were crushed on the day of arrival, 227.5 lbs. in all making 17.63 gals. of wine. The temperature of the must at crushing was 66.5°, and the maximum reached was 77°, on the third day.

The wine was dry on the eleventh day, when it was racked off the lees. At one month the wine was still cloudy, but the lees were sound. At two months the wine was bright, had light bouquet, full and pleasing but not marked flavor, sufficient acid, body, and alcohol; in general, of good quality. At four and at six months examination of the lees showed them to be sound. At six months the wine was bright, clean-tasting, and well developed. At fourteen months it showed good bouquet, full, rich flavor, was quite mature, sound, and clean-tasting. Two months later it was racked and part put in bottle. Six months later the remainder was bottled. At three years the bottled wine was in good order and of good quality, but without marked or special character. That first bottled had the best aroma, but tasted a little raw.

No. 1424. *Steinschiller*, from Mission San José. A sample for must analysis was received October 31, 1890, in good condition; well colored and mature. The must showed 23.7% of solid contents by spindle and 0.53% of acid.

No. 1783. *Steinschiller*, from Mission San José. A sample for must analysis was received October 21, 1892, in poor condition. The must showed 17.35% of solid contents by spindle and 0.73% of acid. The grapes were fermented with No. 1784, Grüner Veltliner, in the proportion of 124 lbs. of the former to 144.5 lbs. of the latter. The temperature of the must at pressing was 66°, and the maximum reached was 78°, on the third day.

In one month the wine was quite clear, and was racked and taken to the cellar. At three months the wine was bright, smooth, and pleasing, without much flavor or bouquet, but sound and good. Two months later it had developed a good bouquet, and was racked for the second time. After this it remained in good order, and at fourteen months was very good and nearly mature. At seventeen months it was bottled.

No. 1996. *Steinschiller*, from Mission San José. A sample for must analysis was received October 1, 1893, in good condition, but not quite mature. The bunches were large, conical, heavily shouldered and winged, close; the berries under medium in size, round, and firm. The must showed 21.7% of solid contents by spindle and 0.73% of acid.

No. 2016. *Steinschiller*, from Mission San José. Received October 26, 1893, in good condition, but not quite mature. The bunches were over medium in size, branching, irregular, well filled, and with very heavy peduncles; berries from small to medium, round, dull red, with very astringent skin and small seeds. The 139.5 lbs. of grapes were made up into 12 gals. of white wine. The temperature of the must at pressing was 69°, and the maximum reached was 75°, on the third day.

In one month the wine was clear, and was racked and taken to the cellar. At three months it was bright, with a little bouquet, not much flavor, full acid—a clean, neutral wine. Two weeks later it was racked for the second time, and at six months it was a very robust, clean-tasting wine, without much character, but pleasing. After this it remained in good order, a good neutral wine, but did not improve much. At fifteen months the lees showed *S. pastorianus*, and the wine was bright, but lacking in character.

No. 2068. *Steinschiller*, from Paso Robles station. Received November 3, 1893, in good condition, but not quite mature. The bunches were small to medium, well filled, irregularly conical, sometimes branching; berries round, under medium in size, green or pink, fresh-tasting, with astringent skin and without much flavor. The must showed 21.5% of solid contents by spindle and 0.43% of acid. The grapes were crushed on the day received, and 108 lbs. yielded 8.13 gals. of wine. The temperature of the must at pressing was 64°, and the maximum reached was 76°, on the fourth day. The must fermented very slowly, and on the ninth day, when still sweet, it was fortified for sweet wine.

A month after fortifying it was not quite bright and tasted a little too sweet. A week later it was racked and put in the hot chamber, at a temperature of 95°, where it was kept for three months. At eight months it was racked again. At twenty months it was perfectly bright, of a beautiful golden color, without much aroma, but with clean taste and good promise.

No. 2103. *Steinschiller*, from Cupertino. A sample for must analysis was received November 3, 1893, in good condition. The bunches were of medium size or under, conical, shouldered or with one or two wings nearly as large as the main bunch, compact; berries medium size, round, of a purplish-brown color, juicy, and with a very astringent skin. The must showed 21.20% of solid contents by spindle and 0.43% of acid.

SLANKAMENKA.

Synonym: Mayarka.

Description.—Vine very vigorous and fruitful, with thick, short-jointed canes; leaves shining, yellowish-green, five-lobed, and a little woolly below; bunches large, conical, and well filled; berries of medium size, oval, yellowish-white, becoming slightly tinged with red where exposed to the sun, pulpy, thick-skinned, and not easily injured by the weather.

This variety is, next to the Steinschiller, the most widely cultivated in southern Hungary for the production of ordinary, light white wines. It bears heavily with short-pruning, and is very free from injury by the ordinary diseases of the vine. It has borne fair crops at the Experiment Stations, but has not exhibited the great productiveness which is claimed for it in Hungary. It has, on the contrary, attained a higher percentage of sugar here than in Europe, and gives a very agreeable wine.

ANALYSES OF MUSTS AND WINES.

SLANKAMENKA.	Date of Picking.	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body
						By Weight	By Volume		
1889—No. 1197. J. T. Doyle, Cupertino	Oct. 23	18.80	17.71	.39	.41	6.42	8.07	.46	1.63
1890—No. 1410. J. T. Doyle, Cupertino	Oct. 27	18.20	......	.62	....	......	......	......	......
1893—No. 1988. J. Gallegos, Mission San José	Oct. 18	25.95	25.19	.54	.30	10.16	12.64	.50	2.60
No. 2092. J. T. Doyle, Cupertino	Nov. 5	23.30	......	.59	....	......	......	......	....
1894—No. 2228. Mission San José	Oct. 5	22.00	......	.55	....	......	......	......	......

RECORD OF TREATMENT.

No. 1197. *Slankamenka*, from J. T. Doyle, Cupertino. Received October 24, 1889, in poor condition. In spite of their European reputation for good keeping qualities, the grapes were injured by the rain. The must showed 18.8% of solid contents by spindle and 0.39% of acid. The bunches were of average size, conical, shouldered, and compact; the berries of medium size, slightly oval, thick but not tough skin, with firm but juicy flesh, of yellowish color, much spotted, and of neutral flavor. The peduncles and pedicels were short. The temperature of the grapes at crushing was 68°, and the maximum reached was 75°, on the third day.

At seven weeks the wine was clear, very light-colored, smooth, and with nutty flavor, but without aroma; it was of rather low acid and good quality. At this time it was racked for the second time and taken to the cellar. At ten weeks the lees showed *Mycoderma vini*, and a month later the wine showed the effect of secondary ferments, and was not clear, so it was pasteurized. A month later it was clear, but much deteriorated in flavor by the presence of volatile acids. After this it rapidly deteriorated.

No. 1410. *Slankamenka*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 30, 1890, in good condition; nearly ripe, but not sweet. The must showed 18.2% of solid contents by spindle and 0.62% of acid.

No. 1988. *Slankamenka*, from Mission San José. Received October 19, 1893, in good condition. The bunches were of medium size, irregularly conico-cylindrical, with or without small wings, well filled but not compact, on very thick, herbaceous peduncles; berries small, ovoid, crisp, juicy, on slender pedicels. The grapes were mature and very fresh-tasting, but without special flavor. The must showed 25.95% of solid contents by spindle and 0.54% of acid. The temperature of the grapes at crushing was 63°, and the maximum reached was 78°, on the third day. The wine was nearly dry on the eighth day, when it was drawn off.

At one month the wine was not clear and was still fermenting a little. Two weeks later, when it was racked for the second time and taken to the cellar, it was still a little sweet. At four months it was racked for the third time; it was bright, of good flavor and aroma, very clean-tasting and fresh, but without marked character. At eight months it tasted very smooth and agreeable. At ten months it was nearly mature, was in good order, smooth, with agreeable acidity, and had developed some bouquet. A week later it was bottled.

No. 2092. *Slankamenka*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were over medium in size, conical, heavily shouldered, well filled; the berries of medium size, slightly oval, crisp, thick-skinned, and astringent. The grapes were mature, and the must showed 23.3% of solid contents by spindle and 0.59% of acid.

BAKATOR.

Synonym: Bacador.

Description.—Vine vigorous; canes strong, somewhat erect, with large joints, the younger parts woolly; leaves large, deeply lobed, often with closed sinuses, short-toothed, glabrous above, more or less woolly below, petioles woolly; bunches large, spreading, irregular; berries of medium size, round, crisp, juicy, of neutral flavor and bright rose color. The down on the leaves varies much with locality. At Cupertino and Mission San José the leaves are white woolly below; at Tulare they are green below and much less woolly. The down on the young canes and leaf stalks seems constant. At Tulare the grapes do not color well.

The Bakator is cultivated principally at Arad, in Hungary, and in Transylvania. It requires a warm climate, and grows well even in very poor soils. It bears well with half-long pruning, but when short-pruned coulures very badly. The grapes are very agreeable to eat, and ornamental for the table when well colored. They are, however, too delicate for shipping, and, as they are neither very early nor very late, the planting of more than a few vines for home use cannot be recommended. In Hungary, the wine of the Bakator is said to be smooth, of low acidity, and very alcoholic. In California, so far, it has made a neutral, clean-tasting wine, but not of quality sufficient to encourage its propagation, especially in view of its extreme liability to coulure.

ANALYSES OF MUSTS AND WINES.

BAKATOR.	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six Months	Body
1890—No. 1319. Cupertino	Oct. 11	24.05	......	.71	....	......	......	......	....
1891—No. 1537. Paso Robles	Oct. 6	22.60	......	.48	....	......	......	......	....
1892—No. 1728. Paso Robles	Oct. 10	24.80	......	.47	....	......	......	......	....
1893—No. 1841. Amador station	Sept. 5	18.80	......	.66	....	......	......	......	....
No. 2011. Mission San José	Oct. 26	20.60	19.90	.80	.25	......	......	......	....
No. 2080. Paso Robles	Nov. 2	24.80	23.61	.44	.32	10.01	12.54	.40	2.10
No. 2089. Cupertino	Nov. 5	21.50	......	.83	....	......	......	......	....
1894—No. 2179. Amador station	Sept. 24	24.80	......	.49	....	......	......	......	....
No. 2202. Tulare	Sept. 27	25.00	......	.41	....	......	......	......	....
No. 2232. Mission San José	Oct. 5	20.30	......	.62	....	......	......	......	....

RECORD OF TREATMENT.

No. 1319. *Bakator*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 13, 1890, in good condition. The must showed 24.05% of solid contents by spindle.

No. 1537. *Bakator*, from Paso Robles station. A sample for must analysis arrived October 8, 1891, in good condition. The bunches were of medium size, rather loose; the berries of medium size and well colored. The grapes were mature, and the must showed 22.6% of solid contents by spindle.

No. 1728. *Bakator*, from Paso Robles station. A sample for must analysis arrived October 13, 1892, in good condition. The must showed 24.8% of solid contents by spindle.

No. 1841. *Bakator*, from Amador station. A sample for must analysis arrived September 8, 1893, in good condition, but not mature. The bunches were of medium size, the berries small and very unevenly colored. The must showed 18.8% of solid contents by spindle.

No. 2011. *Bakator*, from Mission San José. A sample for must analysis arrived October 26, 1893, in good condition. The bunches were large, irregularly branching, short, very loose, and much coulured; the berries under medium in size, crisp, with high, fresh-tasting acid; the peduncles of the bunches were very large. The must showed 20.6% of solid contents by spindle.

No. 2080. *Bakator*, from Paso Robles station. Received November 4, 1893, in fair condition; a little moldy. The bunches were large, spreading, and loose; the berries of medium size, fairly well colored, and very sweet. The must showed 24.8% of solid contents by spindle. The fermentation was slow and prolonged, and reached its maximum temperature of 78° on the third day.

The wine was clear in three weeks from crushing. It was racked three times during the first three months. At six months it was clear and clean-tasting, with a little bouquet, but without much body or character.

No. 2089. *Bakator*, from J. T. Doyle, Cupertino. A sample for must analysis arrived November 6, 1893, in good condition. The bunches were over medium size, irregularly branching, much coulured; the berries of medium size, well colored, crisp, with full acid, but mature. The must showed 21.5% of solid contents by spindle.

GREEN HUNGARIAN.

Synonym: Long Green.

Description.—Vine a strong grower, with long, grayish-brown canes; leaves slightly lobed, acutely serrate, glabrous above and hairy below; bunches large, conical, with small shoulders, close; berries over medium in size, round, thin-skinned, juicy, covered with bloom.

This is one of the many grapes which have appeared in California without any record of their origin. It is very likely the "Weisse Heunisch," with which Goethe's description agrees very well. It is a heavy bearer in localities to which it is suited. At Tulare, with the system of pruning to which it has been subjected, it has produced very little, but has shown itself a very vigorous grower. It is a somewhat tasteless grape, but makes a good, light, neutral wine.

Analyses of Musts and Wines.

GREEN HUNGARIAN.	No. 1403. Cupertino.	No. 2004. Tulare.	No. 2094. Cupertino.
Date of picking	Oct. 21, 1890	Oct. 21, 1893	Nov. 4, 1893
Must.			
Solid contents by spindle	20.40	21.50	20.00
Acid as tartaric	.65	.48	.64
Ash	.31	.45	----------
Wine.			
Alcohol by weight	9.20	----------	----------
Alcohol by volume	11.45	----------	----------
Acid at five months	.57	----------	----------
Body	1.75	----------	----------

Record of Treatment.

No. 1403. *Green Hungarian*, from Cupertino. Received October 23, 1890, in good condition. The bunches were of medium size, conical, shouldered, well filled, but not compressed, on thin stems; berries round, spotted, with thin but tough skin, and light bloom; flesh soft, juicy, and with neutral flavor. The must showed 20.4% of solid contents by spindle and 0.65% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 81°, on the third day. On the fifth day the wine was dry. On the eighth day the wine was racked off the thick lees. At one month the wine was clear, and was racked for the second time. It was of neutral flavor and without aroma, clean-tasting, with full acid and low body. At three months the wine was racked again, and the lees were examined at two, three, five, and seven months, and found to be sound. At seven months the wine was bright, maturing well, not of high quality, but a good neutral wine. At fourteen months it was bright, pleasing, and nearly mature. Three months later it was racked again and part put in bottle. At twenty-three months it was all bottled. At three years and three months both samples were bright and sound; that bottled first was fresher-tasting and showed more flavor and aroma; they were, however, both good, clean-tasting wines, without marked character.

No. 2004. *Green Hungarian*, from Tulare station. A sample for must analysis was received October 23, 1893, in good condition. The bunches were of good size, conical, with small shoulders, close but not compacted; berries over medium in size, round, thin-skinned, juicy, sweet, and commencing to shrivel. The must showed 21.5% of solid contents by spindle and 0.48% of acid.

No. 2094. *Green Hungarian*, from Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were large and with branches almost equaling the main bunch, close; the berries were small, round, soft, juicy, and without flavor. The must showed 20.0% of solid contents by spindle and 0.64% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF AUSTRIAN AND HUNGARIAN TYPE.

Number	LOCALITY.	Vintage of	MUST.			WINE.			
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Months	Body
	Wälschriesling.								
1158	Cupertino	1889	23.50	23.13	.36	.29	13.27	.36	1.85
2028	Cupertino	1893	23.70		.75				
1240	Fresno	1890	26.90	27.13	.39	.40	13.64	.50	2.08
1309	Mission San José	1890	21.70		.57	.27	11.09	.34	1.90
1550	Paso Robles	1891	26.35		.40				
1741	Paso Robles	1892	25.20		.43				
1886	Paso Robles	1893	26.00		.45				
1915	Paso Robles	1893	26.70	26.31	.41	.40	13.27	.30	2.30
1806	Amador station	1893	20.00		.86				
2142	Amador station	1894	27.20		.44				
	Average, Cupertino		**23.60**	**23.13**	**.55**	**.29**	**13.27**	**.36**	**1.85**
	Average, Paso Robles		**25.81**	**26.31**	**.42**	**.40**	**13.27**	**.30**	**2.30**
	Average, Amador station		**23.60**		**.65**				
	Grüner Veltеliner.								
1108	Cupertino	1889	25.60	25.76	.46	.40	12.82	.48	2.55
1306	Cupertino	1890	25.90		.54	.33			
2101	Cupertino	1893	28.00		.51				
1208	Fresno	1890	23.30	22.23	.53	.40	11.45	.32	1.80
1454	Fresno	1891	26.60		.48		12.82	.44	2.95
1605	Mission San José	1891	23.50	24.12	.53		12.00	.40	2.15
1346	Mission San José	1890	25.20		.51	.30	13.73	.47	2.58
1784	Mission San José	1892	24.25		.55				
1989	Mission San José	1893	24.80	23.61	.60		13.09	.57	2.30
2252	Mission San José	1894	23.50		.49				
1803	Amador station	1893	19.30		.87				
	Average, Cupertino		**26.50**	**25.76**	**.50**	**.36**	**12.82**	**.48**	**2.55**
	Average, Fresno		**24.95**	**22.23**	**.50**	**.40**	**12.13**	**.38**	**2.37**
	Average, Mission San Jose		**24.25**	**23.86**	**.53**	**.30**	**12.94**	**.48**	**2.34**
	Rothgipfler.								
1105	Cupertino	1889	28.20	28.07	.46	.34	14.00	.39	2.20
1359	Cupertino	1890	28.00		.46				
1580	Paso Robles	1891	26.50		.34				
1722	Paso Robles	1892	25.20		.41				
1800	Amador station	1893	21.10		.87				
2143	Amador station	1894	28.90		.35				
2238	Mission San José	1894	22.60		.49				
	Average, Cupertino		**28.10**	**28.07**	**.46**	**.34**	**14.00**	**.39**	**2.20**
	Average, Paso Robles		**25.85**		**.37**				
	Average, Amador station		**25.00**		**.61**				
	Peverella.								
1190	Cupertino	1889	20.40		.50	.22	9.73	.36	1.55
1406	Cupertino	1890	23.05		.87	.27	12.09	.57	2.32
1602	Cupertino	1891	20.85	20.24	.67	.30	10.83	.52	2.05
1426	Mission San José	1890	29.10		.92				
1782	Mission San José	1892	23.15		.80				
2015	Mission San José	1893	23.10	21.22	.94	.23	12.09	.67	2.80
2300	Mission San José	1894	19.75		.67				
1463	Fresno	1891	23 92	22.67	.74	.43	11.73	.48	2.25
1743	Paso Robles	1892	24.35		.41				
1836	Amador station	1893	22.60		.89				
2191	Amador station	1894	26.90		.51				
1941	Tulare	1893	24.40		.50				
2330	Tulare	1894	26.90		.38				
	Average, Cupertino		**21.43**	**20.24**	**.68**	**.33**	**10.88**	**.48**	**1.97**
	Average, Mission San Jose		**23.77**	**21.22**	**.83**	**.23**	**12.09**	**.67**	**2.80**
	Average, Amador station		**24.75**		**.70**				
	Average, Tulare		**25.43**		**.44**				

SUMMARY OF ANALYSES OF MUSTS AND WINES OF AUSTRIAN AND HUNGARIAN TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eights Month	Body
	Vernaccia.								
1091	Mission San José	1889	24.36	24.64	.66	.37	------	------	------
1422	Mission San José	1890	28.60	------	.66	------	------	------	------
1781	Mission San José	1892	24 80	------	.65	------	------	------	------
2014	Mission San José	1893	24.80	23.80	.84	.32	------	------	------
2305	Mission San José	1894	22.20	------	.51	------	------	------	------
1148	Cupertino	1889	23.15	21.80	.55	.31	12.09	.40	2.45
1400	Cupertino	1890	25.90	------	.68	------	------	------	------
1601	Cupertino	1891	23.70	23.61	.81	.33	------	------	------
2104	Cupertino	1893	24.80	------	1.07	------	------	------	------
1236	Fresno	1890	23.40	23.13	.53	.33	------	------	------
1549	Paso Robles	1891	22.60	21.80	.32	------	------	------	------
1723	Paso Robles	1892	25.45	------	.36	------	------	------	------
2188	Amador station	1894	24.70	------	.38	------	------	------	------
2328	Tulare	1894	23.30	------	.32	------	------	------	------
	Average, Mission San Jose	------	**25.35**	**24.22**	**.66**	**.34**	------	------	------
	Average, Cupertino	------	**24.36**	**22.70**	**.68**	**.32**	**12.09**	**.40**	**2.45**
	Average, Paso Robles	------	**24.02**	**21.80**	**.34**	------	------	------	------
	Furmint (Mosler).								
2189	Amador station	1894	23.15	------	.38	------	------	------	------
	Zierfahndler.								
1133	Cupertino	1889	23.30	23.13	.47	.33	11.27	.44	2.35
1323	Cupertino	1890	24.35	------	.75	------	------	------	------
2090	Cupertino	1893	24.80	------	.60	------	------	------	------
1314	Mission San José	1890	26.50	------	.41	.40	13.27	.50	------
1577	Mission San José	1891	27.35	------	.33	------	13.75	.32	2.70
2280	Mission San José	1894	20.00	------	.53	------	------	------	------
1760	Paso Robles	1892	18.15	------	.46	------	------	------	------
2279	Amador station	1894	22.60	------	.42	------	------	------	------
	Average, Cupertino	------	**24.15**	**23.13**	**.60**	**.33**	**11.27**	**.44**	**2.35**
	Average, Mission San Jose	------	**24.62**	------	**.42**	**.40**	**13.51**	**.41**	**2.70**
	Rother Steinschiller.								
1174	Mission San José	1889	20.50	20.61	.33	.21	10.36	.57	2.32
1424	Mission San José	1890	23.70	------	.53	------	------	------	------
1783	Mission San José	1892	17.35	------	.73	------	8.46	.48	2.10
1996	Mission San José	1893	21.70	------	.73	------	------	------	------
2016	Mission San José	1893	21.50	20 46	.55	.30	11.18	.68	2.60
1201	Cupertino	1889	19.30	18.89	.24	.23	9.82	.33	1.66
1415	Cupertino	1890	20.60	------	.50	.29	11.09	.45	2.14
2103	Cupertino	1893	21.20	------	.50	------	------	------	------
2068	Paso Robles	1893	21.50	20.99	.43	.27	------	------	------
	Average, Mission San Jose	------	**20.95**	**20.53**	**.57**	**.25**	**10.27**	**.63**	**2.46**
	Average, Cupertino	------	**20.36**	**18.89**	**.41**	**.26**	**10.45**	**.39**	**1.90**
	Slankamenka.								
1197	Cupertino	1889	18.80	17.71	.39	.41	8.07	.46	1.63
1410	Cupertino	1890	18.20	------	.62	------	------	------	------
2092	Cupertino	1893	23.30	------	.59	------	------	------	------
1988	Mission San José	1893	25.95	25.19	.54	.30	12.64	.50	2.60
2228	Mission San José	1894	22.00	------	.55	------	------	------	------
	Average, Cupertino	------	**20.10**	**17.71**	**.52**	**.41**	**8.07**	**.46**	**1.63**
	Average, Mission San Jose	------	**23.65**	**25.19**	**.54**	**.30**	**12.64**	**.50**	**2.60**
	Bakator.								
1319	Cupertino	1890	24.05	------	.71	------	------	------	------
2089	Cupertino	1893	21.50	------	.83	------	------	------	------
1537	Paso Robles	1891	22.60	------	.48	------	------	------	------
1728	Paso Robles	1892	24.80	------	.47	------	------	------	------

SUMMARY OF ANALYSES OF MUSTS AND WINES OF AUSTRIAN AND HUNGARIAN TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at Six to Eight Months	Body
	Bakator—Continued.								
2080	Paso Robles	1893	24.80	23.61	.44	.32	12.54	.40	2.10
1841	Amador station	1893	18.80	......	.66	......	......	......	......
2179	Amador station	1894	24.80	......	.49	......	......	......	......
2011	Mission San José	1893	20.60	19.90	.80	.25	......	......	......
2232	Mission San José	1894	20.30	......	.62	......	......	......	......
2202	Tulare	1894	25.00	......	.41	......	......	......	......
	Average, Cupertino	......	**22.77**	......	**.77**	......	......	......	......
	Average, Paso Robles	......	**36.06**	**23.61**	**.46**	**.32**	**12.54**	**.40**	**2.10**
	Average, Amador station	......	**21.80**	......	**.57**	......	......	......	......
	Average, Mission San Jose	......	**22.30**	**19.90**	**.61**	**.25**	......	......	......
	Green Hungarian.								
1403	Cupertino	1890	20.40	......	.65	.31	11.45	.57	1.75
2094	Cupertino	1893	20.00	......	.64	......	......	......	......
2004	Tulare	1893	21.50	......	.48	.45	......	......	......
	Average, Cupertino	......	**20.20**	......	**.64**	**.31**	**11.45**	**.57**	**1.75**

PORT TYPE.

(See Vit. Rept. 1887-89, p. 255.)

Though the Portuguese are notoriously careless wine-makers, it is only lately and to a limited extent that we have been able to make Ports which approach their best wines in quality. This is due to a variety of causes. The proper Port grapes have been planted to a very limited extent only. The localities where most of the Ports have been made lack that advantage of soil and situation possessed by the banks of the Douro. Even when Port is made in a good locality it is but too often only an attempt to give a new lease of life to a moribund dry wine, or it is made from grapes which do not possess the composition and characteristics necessary to the production of a good Port. The Ports of the Douro also owe much of their excellence to skillful handling, and especially blending, after fermentation. The wines are partially fortified at the vineyard prior to, during, or immediately after fermentation, and shipped to the large storage cellars. The fermentation is thus sometimes prolonged for months. As the fermentation and fortifying are carried on, as a rule, in a somewhat haphazard way, the wines arrive at the storage cellars with very varying degrees of alcohol and sugar. They are, however, immediately blended and refortified, in order to make a uniform product. The wines are subjected to thorough aëration, both during fermentation and in subsequent handling. This is a point generally neglected in California. It is also worthy of note that all the best Ports are made from a mixture of grapes. This has been the experience with the wines made at the Experiment Stations. No grape, so far tested, makes a thoroughly satisfactory Port alone. Tinta de Madeira is the nearest to being an exception, but even this variety is improved by an addition of Tinta Câo or Mourisco Preto.

Red liqueur wines are not made so commonly as the white, but in most wine-making countries a little is produced. The red Muscats of Italy and the sweetish "auslese" wines of Germany may be included in this group.

TINTA DE MADEIRA.

(See Vit. Rept. 1883–85, p. 140; 1887–89, p. 270.)

Synonym: Negramol.

Description.—Vine fairly vigorous; canes very light-colored; leaves of medium size, obtusely serrate, slightly or not at all lobed, petiolar sinus quite closed, young shoots tomentose, older leaves glabrous above with more or less loose tomentum below; bunches of medium size, conico-cylindrical, generally close, shouldered, on herbaceous peduncles; berries of medium size, juicy, tender-skinned, on slender pedicels.

The Negramol, so called from the soft feel of the berries and the dark color of the skin, according to its reputation in the island of Madeira, should make a deep-colored, very astringent wine. In California it makes a wine with a fair amount of color, which, however, soon deposits and turns yellowish. The astringency varies very much with the locality. In the northern coast counties it is sufficiently high for a dry wine, but in warmer localities the tannin contents are low. The vine bears well with long or half-long pruning, and the grapes attain very regularly a high percentage of sugar. The acid is full for a Port grape, but it is admirably suited to the purpose. It has a smoothness and roundness of flavor which makes it much more desirable for this purpose, used alone, than any of the other Port grapes tried. It is improved, however, by blending with Tinta Amarella or Mourisco preto, and can be recommended for planting as a Port grape with some good bearing variety of less character and lower acidity.

The bunches are almost always perfectly sound, and coulure is very rare.

ANALYSES OF MUSTS AND WINES.

TINTA DE MADEIRA.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
						By Weight	By Volume		At Pressing	At Six Months		
1890—No. 1247. Fresno	Aug. 24	24.80	24.22	.50	.43	15.25	18.78	.126	.45	.38	4.02	1.40
No. 1301. Mission San José	Oct. 5	23.70	......	.52	.30	9.41	11.73	.241	.53	.38	2.82	......
No. 1363. Cupertino	Oct. 14	27.45	......	.54	.35	16.23	19.96	.164	.56	.53	4.32	.96
1891—No. 1459. Fresno	Aug. 28	24.80	......	.57	......	15.25	18.78	.225	.53	.47	3.25	.23
No. 1487. Paso Robles	Sept. 9	21.50	......	.48	......	......	......	......	......	......	......	......
No. 1567. Mission San José	Oct. 6	24.53	......	.48	......	17.08	20.99	.270	.65	.43	2.95	......
1892—No. 1630. Tulare	Sept. 3	23.70	......	.42	......	16.31	20.06	.126	.50	.44	3.35	1.75
No. 1651. Paso Robles	Sept. 13	25.86	......	.59	......	......	......	......	......	......	......	......
No. 1771. Mission San José	Oct. 13	23.05	22.67	.56	......	14.73	18.14	.136	.63	.50	2.86	1.34
1893—No. 1850. Amador station	Sept. 13	23.90	21.38	.56	.33	13.41	17.26	.096	.56	.68	3.00	2.50
No. 1896. Paso Robles	Sept. 26	26.70	26.31	.39	.37	16.53	21.19	.115	.38	.41	3.22	1.08
No. 1977. Tulare	Oct. 14	24.40	......	.42	.40	......	......	......	.38	......	......	......
No. 2056. Cupertino	Nov. 1	24.80	......	.56	......	......	......	.320	......	......	......	......
No. 2072. Mission San José	Nov. 3	26.30	25.76	.44	.27	......	......	......	......	......	......	......
1894—No. 2146. Amador station	Sept. 13	26.50	......	.48	......	......	......	......	......	......	......	......
No. 2255. Mission San José	Oct. 5	22.60	......	.44	......	......	......	.237	......	......	......	......
No. 2337. Tulare	Oct. 19	25.90	......	.39	......	......	......	......	......	......	......	......

TINTA DE MADEIRA.		COLOR READINGS.													
		At Pressing.		One Month.		Two Months.		Three Months.		Four Months.		Five Months.		Six Months.	
1890—No. 1247.	Fresno	38.8	4VR	12.3	2VR+2Y	11.4	4VR+2Y	7.1	1R+2Y	......		......		......	
No. 1301.	Mission San José	43.4	2VR	24.3	4VR	16.5	5VR	12.1	1R	10.8	3VR+1Y	9.8	5VR+1Y	11.0	4VR+1Y
No. 1363.	Cupertino	34.8	5VR	18.5	5VR+1Y	19.2	1R+1Y	12.5	3R+2Y	......		......		......	
1891—No. 1459.	Fresno	13.3	R	12.2	1R	23.0	1VR+1Y	19.5	2VR+1Y	16.4	5VR+1Y	11.3	3R+1Y	......	
No. 1567.	Mission San José	111.1	1VR	25.0	R to 1R	28.6	1VR+1Y	25.5	3VR+1Y	22.1	4VR+1Y	......		......	
1892—No. 1630.	Tulare	22.8	2VR	12.9	1VR+1Y	12.9	1VR+1Y	14.0	1VR+1Y	14.0	4VR+1Y	12.9	5VR+1Y	......	
No. 1771.	Mission San José	121.0	2VR	41.6	4VR	22.5	1R	21.6	1R	21.6	1R	......		......	
1893—No. 1850.	Amador station	39.2	3VR	22.3	1R	18.5	2R	16.3	2R	......		......		......	
No. 1896.	Paso Robles	22.5	5VR	11.6	3R	13.3	4R	......		......		......		......	
No. 1977.	Tulare	26.8	4VR	......		......		......		......		......		......	
No. 2056.	Cupertino	40.0	4VR	......		......		......		......		......		......	
No. 2072.	Mission San José	62.5	2VR	......		......		......		......		......		......	

Record of Treatment.

No. 1247. *Tinta de Madeira*, from Fresno. Received August 27, 1890, in fair condition, and quite mature. The must showed 24.8% of solid contents by spindle and 0.50% of acid. The grapes were crushed at a temperature of 67°, and placed in a room which was kept at a temperature of between 91° and 98°. The wine fermented strongly, and reached a maximum temperature of 95° on the second day. On the third day the pomace was pressed and the wine fortified with 70% spirits.

At five months the wine was quite bright, but tasted raw. It was racked and put in a heating-chamber at a temperature of 110°, where it remained for three months. One month after removal from the heating-chamber the wine was clear, very well constituted, but somewhat coarse and rough. At eighteen months the wine was racked for the fourth time. It was a very fair Port, with rich bouquet and some flavor, much toned down and improved. After this it did not improve, being in too small a quantity to keep well.

No. 1301. *Tinta de Madeira*, from Mission San José. Received October 7, 1890, in poor condition, many of the grapes being moldy. The grapes were crushed and fermented as dry wine. The temperature at crushing was 71°, and the maximum reached was 90°, on the third day. On the sixth day the wine was dry and was pressed.

One month after crushing the wine was nearly clear. At two months the wine was fermenting a little and had a slightly bitter taste, but the lees appeared sound on microscopic examination. It was nearly clear, of full and pleasing flavor, low acid, full astringency, good body, and a slightly moldy odor. After this it deteriorated and showed poor keeping qualities.

No. 1363. *Tinta de Madeira*, from Cupertino. Received October 17, 1890, in good condition, and mature. The must showed 27.45% of solid contents by spindle and 0.54% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 94°, on the third day. On the fourth day the wine was drawn off and fortified.

Three months after pressing the wine was not quite clear, tasteless, and of low quality. It was racked and put in a heating-box, at a temperature of 110°, where it was left for three months. One month after taking from the heating-chamber it was improved in flavor, but still not clear or clean-tasting. It was then racked for the third time. At sixteen months it was clear and had developed a little bouquet, but was without flavor, a little bitter, and poor generally. A year later it had improved somewhat, but was at best only a second-rate Port. At four years it had improved a little more and was put in glass. Fourteen months after putting in glass the wine was much improved, and was an agreeable Port with some bouquet, little flavor; a smooth, neutral wine, without positive defect, but lacking in character, and very light in color.

No. 1459. *Tinta de Madeira*, from Fresno. Received August 31, 1891, in good condition. The must showed 24.8% of solid contents by spindle and 0.57% of acid. Only a small quantity of grapes was crushed, and the temperature of the must varied from 66° at crushing to 84° on the fifth day. On the fifth day the wine was drawn off the pomace, and on the sixth day fortified with 70% spirits.

Four months after pressing the wine was bright, of good flavor and color, and clean-tasting, but a little too dry. Two months later it was racked and put in the heating-chamber, at a temperature of from 90° to 95°, where it was left for three months. At three years it had marked Port character, but was too dry and a little bitter. At four years it was a Port of very marked character, with strong bouquet and flavor. It was of too pronounced character for use alone, and required toning-down by blending.

No. 1487. *Tinta de Madeira*, from Paso Robles station. A sample for must analysis was received September 11, 1891, in good condition. The must showed 21.5% of solid contents by spindle and 0.48% of acid.

No. 1567. *Tinta de Madeira*, from Mission San José. Received October 9, 1891, in fair condition, and mature. The must showed 24.53% of solid contents by spindle and 0.48% of acid. The temperature of the grapes at crushing was 60°, and the maximum reached was 84°, on the fourth day. The wine was drawn off on the fourth day, and fortified on the sixth.

Three months after pressing the wine was clear, of good color and full flavor, but rather too dry. A month later it was racked and put in the heating-chamber, at a temperature of from 90° to 95°, where it remained three months. At thirteen months it was in good condition, and had improved. It was rather lacking in flavor, but the bouquet was good and the sweetness had increased to the right degree by evaporation. At four years it was an agreeable Port, with less character and more color than wine from the same grape from Fresno, and had a slight but not unpleasant bitterness.

No. 1630. *Tinta de Madeira*, from Tulare station. Received September 6, 1892. There is some doubt as to the identity of this lot. The grapes came mixed with Tinta Amarella, and appeared to be Tinta de Madeira, though in the absence of leaves its identity was uncertain. The grapes were in good condition, and mature. The temperature at crushing was 69°, and the maximum reached was 85°, on the third day. On the fourth day the wine was drawn off and fortified.

At three months the wine was bright and of good quality, but rather too dry. At six months it was racked, sweetened and refortified, and put in the heating-chamber, at a temperature of from 90° to 95°, where it was left for three months. At one year it was in good condition, a full-flavored, clean-tasting, and very agreeable Port. At three years the wine retained its good qualities, and had improved. It was less marked in character than the wine from the same grape from Fresno, but was better wine to use unblended.

No. 1651. *Tinta de Madeira*, from Paso Robles station. A sample for must analysis was received September 16, 1892, in good condition. The must showed 25.86% of solid contents by spindle and 0.59% of acid.

No. 1771. *Tinta de Madeira*, from Mission San José. Received October 15, 1892. The must showed 23.05% of solid contents by spindle and 0.56% of acid. The temperature of the must at crushing was 58°, and the maximum reached was 85°, on the fourth day. The wine was dry on the fifth day, when it was drawn off and fortified.

At one month the wine was clear, and at two months it was bright and promising. At five months it was racked for the third time, sweetened, fortified, and put in the heating-chamber, where it was kept at a temperature of from 90° to 95° for three months. At nine months it was bright and of good quality. At two years it was somewhat lacking in flavor and too acid. At four years it was much improved in bouquet and flavor, very clean-tasting, but a little thin, and required blending with a heavier wine.

No. 1850. *Tinta de Madeira*, from Amador station. Received September 15, 1893, in good condition. The bunches and grapes were very small, and showed damage from *oidium*. The must showed 23.9% of solid contents by spindle and 0.56% of acid. The grapes were fermented in a temperature of from 80° to 85°. On the fifth day the wine was drawn off and fortified. The wine did not turn out well, and was without color or character.

No. 1896. *Tinta de Madeira*, from Paso Robles station. Received September 28, 1893, in good condition, and mature. The must showed 26.7% of solid contents by spindle and 0.39% of acid. The bunches were small and compact; the berries small and with little color. The temperature of the must at crushing was 66°, and the maximum reached was 90°, on the fourth day. On the fifth day the wine was drawn off and fortified.

At two months the wine was bright and well constituted. It was racked and put into the heating-chamber, at a temperature of from 90° to 95°, where it was kept for three months. At two years it was a smooth and agreeable Port, with some bouquet and flavor, but not very well developed.

No. 1977. *Tinta de Madeira*, from Tulare station. A sample for must analysis was received October 16, 1893, in good condition, and mature. The bunches were rather small, conical, well filled, but not compact; berries of medium size, slightly oval, very soft, and juicy. The must showed 24.4% of solid contents by spindle and 0.42% of acid.

No. 2056. *Tinta de Madeira*, from Cupertino. A sample for must analysis was received October 30, 1893, in good condition. The bunches were small, irregular, well filled; berries small, juicy, and very ripe. The must showed 24.8% of solid contents by spindle and 0.56% of acid.

No. 2072. *Tinta de Madeira*, from Mission San José. A sample for must analysis was received November 3, 1893, in good condition. The bunches were under medium size, conical, with small wings, and well filled; the berries were small, round, pulpy, but soft and thin-skinned, and quite mature. The must showed 26.3% of solid contents by spindle and 0.44% of acid.

TINTA AMARELLA.

(See Vit. Rept. 1883–85, p. 140; 1887–89, p. 260.)

Description.—Vine a strong grower; bunches large, pyramidal or conical, heavily shouldered, close; berries medium size, but irregular, varying from very small to rather large, and from nearly round to distinctly oval; skin rather thick, but not tough; flesh firm, but juicy; flavor sweet, not marked; peduncle thick, strong, and woody; pedicels rather long and of medium strength.

The Tinta Amarella has maintained its Portuguese reputation as a heavy producer at all the stations except Amador; it requires a richer soil than that in which it is planted there. It is a good grape to plant for the bulk of a Port vineyard, but requires a certain proportion of some variety of higher quality to give it smoothness and character. It makes a good blend with Tinta de Madeira. It is unsuited to the production of dry wine, unless used in small quantities with a grape of more quality, astringency, and better keeping qualities.

Analyses of Musts and Wines.

TINTA AMARELLA.		Date of Picking.	MUST.				WINE.						
			Solid Contents by Spindle.	Sugar by Copper Test.	Acid as Tartaric.	Ash.	Alcohol.		Tannin.	Total Acid as Tartaric.		Body.	Sugar.
							By Weight.	By Volume.		At Pressing.	At Six Months.		
1890—No. 1340.	Mission San José	Oct. 11	22.60	......	.81	.30	9.20	11.45	.107	.62	.44	2.58	......
No. 1388.	Cupertino	Oct. 18	24.25	......	.72	......	9.92	12.36	.210	.60	.51	......	.56
1891—No. 1442.	Tulare	Aug. 26	22.90	......	.51	......	......	......	......	......	......	......	......
No. 1457.	Fresno	Aug. 28	23.70	23.13	.66	.42	13.15	16.24	......	.56	......	3.00	......
No. 1486.	Paso Robles	Sept. 9	21.50	......	.61	......	......	......	......	......	......	......	......
No. 1566.	Mission San José	Oct. 6	23.05	......	.71	......	15.50	19.08	.206	.77	.49	3.28	3.07
1892—No. 1629.	Tulare	Sept. 3	20.85	20.24	.64	.45	17.17	21.09	.093	.56	.53	3.40	1.70
No. 1673.	Tulare	Sept. 16	22.25	21.22	.60	.40	8.48	10.38	.096	.53	.44	3.45	......
No. 1753.	Paso Robles	Oct. 11	22.00	......	.34	......	......	......	......	......	......	......	......
No. 1770.	Mission San José	Oct. 13	21.80	21.38	.86	......	13.85	17.08	.170	.80	.61	2.95	2.00
1893—No. 1878.	Amador station	Sept. 12	18.20	......	.78	.33	......	......	......	.67	......	......	......
No. 1891.	Tulare	Sept. 23	23.70	21.38	.41	.48	......	17.40	.106	.40	......	3.40	0.50
No. 1897.	Paso Robles	Sept. 26	23.70	23.61	.44	.37	......	19.15	.150	.56	.53	3.35	1.25
No. 2059.	Cupertino	Oct. 28	24.60	......	.65	......	......	......	.240	......	......	......	......
No. 2073.	Mission San José	Nov. 3	23.30	21.80	.66	.31	8.98	11.18	.163	.68	.57	2.90	......
1894—No. 2181.	Amador station	Sept. 24	23.90	23.13	.54	......	......	......	.089	......	......	......	......
No. 2291.	Tulare	Oct. 11	24.00	23.13	.49	......	......	......	......	......	......	......	......
No. 2308.	Mission San José	Oct. 13	22.20	......	.62	......	......	......	......	......	......	......	......

RECORD OF TREATMENT.

No. 1340. *Tinta Amarella*, from Mission San José. Received October 14, 1890, in good condition, and mature. The must showed 22.6% of solid contents by spindle and 0.81% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 92°, on the fourth day. At the end of the fourth day the wine was dry, and was drawn off.

The wine remained turbid for some time, and was not clear one month after pressing, when it was racked for the first time; it tasted dry, however, and an examination of the lees showed no unsound germs. At six weeks it was clear, with delicate aroma, clean taste, low acid, and medium astringency. At three months, when the wine was racked for the second time, it was bright and of good quality; the lees showed no unsound germs. Two months later, however, the lees showed some short filaments and the taste of the wine was slightly affected. The wine was then pasteurized, and two months later was bright, very smooth and pleasant, with little character, but sound-tasting. At nine months it was racked for the fourth time. At fifteen months it was bright and nearly or quite mature; it showed little bouquet, but was pleasantly flavored and of agreeable astringency. Two months later it was racked and a part put in bottle; at twenty-three months the rest was bottled. Sixteen months after the second bottling both samples were bright, well flavored, but not delicate; the first bottled was not quite clean-tasting, but the other was a sound, fair wine. Two years later the wine was bright and had retained its color well, but otherwise had deteriorated, showing poor keeping qualities.

No. 1388. *Tinta Amarella*, from Cupertino. Received October 21, 1890, in good condition, and perfectly ripe. The bunches were large and well filled, and some of the berries were beginning to shrivel. The must showed 24.25% of solid contents by spindle and 0.72% of acid. The temperature of the must at crushing was 71°, and the maximum reached was 95°, on the third day. Before the wine was quite dry, six gallons were drawn off and fortified; the remainder was dry on the fourth day, when it was pressed.

At one month the wine was nearly clear, of good aroma, full astringency, and medium acid. At six weeks the lees were examined and found to be sound; the wine was clear, and was racked. At three months the wine was clear, but had a suspicious odor, and an examination of the lees showed unsound germs. The wine was pasteurized, and four months later was bright; it was rather a good wine, with little character, but without positive defect. At eight months it was racked again, and at fifteen months had improved considerably. It was bright, of light color, very little bouquet, but clean and agreeable taste. It was mature, and two months later was racked again and part put in glass; at two years the rest was bottled. Fourteen months after the second bottling both samples were bright; the first bottled was not quite clean-tasting, but the second was a good, common wine, agreeable, but not delicate. Two years later both samples were perfectly bright, but had deteriorated very much.

No. 1442. *Tinta Amarella*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 22.9% of solid contents by spindle and 0.51% of acid.

No. 1457. *Tinta Amarella*, from Fresno. Received August 31, 1891, in fair condition. The must showed 23.7% of solid contents by spindle and 0.66% of acid. The grapes were fermented in two equal lots. The first (No. 1457) was fermented in the ordinary way. The temperature of the grapes at crushing was 76°, and the maximum reached was 82°, on the third day. On the sixth day, when the wine was still a little sweet, it was drawn off and fortified. The second lot (No. 1457*a*) was started in the same way and at the same temperature. On the third day, when it first showed signs of vigorous fermentation, 9% of spirits of 70° strength was added. This addition of alcohol caused the fermentation to proceed more slowly, and the wine was three days longer in dropping to the required degree of sweetness. The wine was drawn off at the same time as the first lot, allowed to ferment for three days in the barrel, and was then fortified in the same way.

No. 1457. At four months the wine was bright, with good aroma, but tasted rough, a little bitter, and too dry. At five months it was racked, and placed in the heating-chamber, at from 90° to 95°, for three months. When the wine was three years old it was in excellent condition, had good aroma and clean taste, but was not quite equal to No. 1457*a*. Fourteen months later it differed little from No. 1457*a*; both were very creditable Ports, and had lost much of the rough, somewhat coarse character they had when young.

No. 1457*a*. At four months the wine was bright, somewhat raw, with a slightly bitter taste, and too dry. At five months it was racked, and placed in the heating-chamber, at a temperature of from 90° to 95°. At three years it was clear, of good aroma, some flavor, of good Port character, though somewhat coarse. Fourteen months later it had improved and become a very good, smooth Port. The color was very light.

No. 1486. *Tinta Amarella*, from Paso Robles station. A sample for must analysis was received September 11, 1891, in good condition. The must showed 21.5% of solid contents by spindle and 0.61% of acid.

No. 1566. *Tinta Amarella*, from Mission San José. Received October 9, 1891, in good condition, and mature. The must showed 23.05% of solid contents by spindle and 0.71%

of acid. The grapes were crushed at a temperature of 60°, and reached a maximum of 73° on the third day, when the wine was drawn off and fortified.

At three months the wine was clear, of full sweetness, and little flavor. A month later it was racked, and two months later put in the heating-chamber, at a temperature of from 90° to 95°, where it remained three months. At three years the wine was clear, light-colored, smooth, and agreeable, with low acid and rather too much sweetness; it was not of very marked aroma, but made a good blend with Ports of more marked character. At four years it had developed some bouquet, and was generally improved. It had a slight but not unpleasant bitterness.

No. 1629. *Tinta Amarella*, from Tulare station. Received September 6, 1892, in good condition, except for a little mold. The must showed 20.85% of solid contents by spindle and 0.64% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 84°, on the third day. On the fourth day the wine was drawn off and fortified.

At three months the wine was bright, clean-tasting, with little color and rather too dry. Three months later it was racked for the second time and placed in the heating-chamber, at a temperature of from 90° to 95°, for three months. When the wine was two years old it was in good condition, and more highly flavored than Tinta de Madeira from the same locality. A blend of Tinta Amarella and Tinta de Madeira in equal parts was much better than either alone. Two years later it had improved very much, was very marked in character, a little bitter, but a good Port and very smooth.

No. 1673. *Tinta Amarella*, from Tulare station. Received September 19, 1892, in good condition. The grapes were very large and fine. The must showed 22.25% of solid contents by spindle and 0.60% of acid. The grapes were crushed at a temperature of 67°, and the maximum of 85° was reached on the third day. On the fourth day the wine was pressed.

The wine was clear in one month, and was racked and taken to the cellar. At three months it was bright, smooth, and pleasing, with little flavor, low acid, and medium astringency. Two months later it was in good condition, and was racked for the second time; it was of poor color. At eight months it was in good condition, clean-tasting, and pleasing. Two months later it was bright and sound, but tasted somewhat flat. At fifteen months it was in good order, but had deteriorated, and was not a success as a dry wine. A month later it was bottled. Two years after bottling the wine was bright and without deposit, but was of poor quality. It had developed something of the Port character, but was evidently a poor keeper and not to be recommended as a dry wine.

No. 1753. *Tinta Amarella*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 22.0% of solid contents by spindle and 0.34% of acid.

No. 1770. *Tinta Amarella*, from Mission San José. Received October 15, 1892, in good condition. The must showed 21.8% of solid contents by spindle and 0.86% of acid. The temperature of the grapes at crushing was 58°, and the maximum reached was 86°, on the fourth day. The wine was drawn off and fortified on the fifth day.

At one month the wine was clear, and was racked off. A month later it was bright and clean-tasting, but too dry. At five months it was racked for the second time, sweetened, and put in the heating-chamber, at a temperature of from 90° to 95°, where it was left for three months. At nine months it was bright, clean-tasting, and well developed. It requires the addition of a smoother wine; makes a good blend with No. 1771, Tinta de Madeira, and also with No. 1674, Mourisco preto. Two years later the wine was fairly good, but too acid and with little Port character. It had kept its color well.

No. 1878. *Tinta Amarella*, from Amador station. Received September 15, 1893, in good condition, but not mature. The bunches were small, the berries varying in size. The must showed 18.2% of solid contents by spindle and 0.78% of acid. There were only 26 lbs. of grapes, and they were made into Port.

At three months the wine was bright and of sufficient sweetness. An analysis showed 4.1% of solid contents and 14% of alcohol. The wine was therefore racked and refortified. Three months later it was racked again, and put into the heating-chamber, at a temperature of from 90° to 95°, for three months. Two months later it was racked again into a demijohn, on account of the small quantity. When the wine was twenty-eight months old it was bright and clean-tasting, but thin and undeveloped. It was, however, a fair wine, considering the unripe grapes from which it was made.

No. 1891. *Tinta Amarella*, from Tulare station. Received September 25, 1893, in good condition; quite mature, very sweet, a few bunches commencing to shrivel. The bunches were conico-cylindrical, slightly or not at all shouldered, compact, and the berries compressed; the berries oval, of medium size, with thick but not tough, well-colored skin, light bloom, soft flesh; the peduncles were thick, and the pedicels rather slender. The vines from which these grapes were gathered were growing in an alkaline soil. Two thirds of the row was in strongly alkaline soil, and the rest in sandy soil with less alkali. The vines were pruned half-long, and bore at the rate of about five tons per acre. The must showed 23.7% of solid contents by spindle and 0.41% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 91°, on the third day. On the third day the wine was drawn off and fortified.

At three months, when the wine was racked for the first time, it was bright and in good order, but not quite sweet enough. At six months it was racked again and put in the heating-chamber, at a temperature of from 90° to 95°, and left there for three months. A month after taking from the heating-chamber it was racked for the third time. At twenty-eight months it was in good order, but still rough and undeveloped; a somewhat coarse Port, but promising.

No. 1897. *Tinta Amarella*, from Paso Robles station. Received September 28, 1893, in fair condition, but somewhat crushed from loose packing, and very dusty. The grapes were mixed with the same variety as the Tulare grapes. These were picked out, and the rest, which were very dusty, washed. The bunches were of medium size, fairly compact; the berries rather small and very sweet. The must showed 23.7% of solid contents by spindle and 0.44% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 84°, on the fourth day. On the fifth day the wine was drawn off and fortified.

At two months and a half the wine was racked; it was bright and too dry. At nine months it was racked again, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. A week after taking from the heating-chamber it was racked again. At twenty-eight months it was in good order, of marked character, but still raw and undeveloped.

No. 2059. *Tinta Amarella*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were of medium size, short conical, close, shouldered; the berries large, nearly round, crisp, quite ripe. The must showed 24.6% of solid contents by spindle and 0.65% of acid.

No. 2073. *Tinta Amarella*, from Mission San José. Received November 3, 1893, in good condition. The bunches were of medium size, conical, shouldered, close; the berries of medium size, round, crisp, juicy, and mature. The must showed 23.3% of solid contents by spindle and 0.66% of acid. The temperature of the grapes at crushing was 60°, and the maximum reached was 88°, on the third day. On the fourth day the wine was dry, and was drawn off.

At one month the wine was not clear and tasted a little bitter. It was racked, and at three months was bright, of good flavor, a little bouquet, good body, low acid, and still slightly bitter. A month later it was racked again, and at six months was much improved, had developed some bouquet, and was in general a pleasant wine. At nine months it was sound and in good order; a smooth, light wine, fresh and clean-tasting, but a little thin. It was racked, and a part put in bottle. At fourteen months it was in good order and mature, but not as good as at nine months. An examination of the lees showed no unsound germs, and the wine was bottled. A year after bottling the wine was bright, of fair quality, but not as good as when examined a year earlier. It had already commenced to become decrepit.

TINTA CÂO.

(See Vit. Rept. 1883-85, pp. 139, 143; 1887-89, p. 266.)

Synonym: Tinta Cam.

Description.—Leaves large, smooth, three-lobed, acuminate, irregularly saw-toothed, with rose-colored petiole, the upper side a green color with some crimson spots, the lower side very slightly downy; canes reddish-colored, bunches not very compact, but of average size and irregular; berries round, bluish-black, pedicels not visible to the end, skin tough and thick, three seeds in the berry; juice sweetish-astringent.

The opinions expressed in the last report regarding the Tinta Câo have been strengthened by subsequent results. For the hot interior valleys it is admirably suited, bearing regularly though not very heavily. It is a very healthy, strong-growing vine, and gives an excellent blending Port. It is somewhat too rough when used alone, but blended with either Tinta de Madeira, Tinta Amarella, or any mild Port variety, it is satisfactory. Blend No. 1772 shows its possibilities as an ingredient in dry red wines. It cannot be recommended for this purpose alone, but if planted for Port in a suitable locality it makes a sufficiently good dry red wine to allow of a change, if dry wine should be desired.

ANALYSES OF MUSTS AND WINES.

TINTA CÂO.	Date of Picking	MUST.			WINE.							
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
						By Weight	By Volume		At Pressing	At Six Months		
1890—No. 1371. Cupertino	Oct. 14	23.25		.52								
No. 1379. Mission San José	Oct. 18	23.07		1.03	.23	9.20	11.45	.222		.42	2.78	
1891—No. 1467. Fresno	Aug. 29	22.40	21.80	.55	.60	13.77	16.98	.095		.18	6.45	8.15
No. 1546. Paso Robles	Oct. 6	22.70		.38								
No. 1568. Mission San José	Oct. 6	21.10		.78		13.15	16.24	.210	.75	.50	2.70	
1892—No. 1697. Tulare	Sept. 27	22.40		.45								
No. 1732. Paso Robles	Oct. 10	23.50		.50								
No. 1769. Mission San José	Oct. 13	22.80	21.80	.97		14.82	18.25	.120	.82	.60	4.20	
No. 1772.* Mission San José	Oct. 13			.63		8.84	11.00	.196	.63	.63	2.80	
1893—No. 1849. Amador station	Sept. 12	20.60	19.41	.79	.30				.55			
No. 1920. Paso Robles	Oct. 10	24.60	23.61	.56	.34		17.00	.100	.52	.69	3.32	0.88
No. 1975. Tulare	Oct. 14	22.60		.71				.413	.69			
No. 2051. Cupertino	Oct. 30	24.60		.72				.246				
1894—No. 2167. Amador station	Sept. 19	25.40	23.61	.48					.48			
No. 2275. Mission San José	Oct. 5	20.20		.71				.166	.65			
No. 2338. Tulare	Oct. 19	26.50		.40								

*Blend of the Tinta Câo, Tinta de Madeira, and Tinta Amarella.

Record of Treatment.

No. 1371. *Tinta Câo*, from Cupertino. A sample for must analysis was received October 17, 1890, in fair condition, a few of the berries being moldy. The must showed 23.25% of solid contents by spindle and 0.52% of acid.

No. 1379. *Tinta Câo*, from Mission San José. Received October 20, 1890, in good condition, and mature. The bunches and berries were very small. The must showed 23.07% of solid contents by spindle and 1.03% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 90°, on the third day. On the fourth day the wine was dry, and was drawn off.

At one month the wine was nearly clear, and showed high acid and astringency, but the odor was not good and it was not clean-tasting. The lees were examined under the microscope, and as no unsound germs were found the wine was racked and taken to the cellar. At three months the lees were examined again and showed unsound germs. The wine was bright, and the flavor had improved, but the odor was still suspicious, so it was pasteurized. Three months after pasteurizing it was bright, had much improved in bouquet, and the disagreeable odor had almost disappeared. At this time it was racked for the third time, and at fourteen months it was clear, but had deteriorated. Two months later it was bottled, but did not keep well. Two years after bottling it showed some good qualities, but was not clean-tasting.

No. 1467. *Tinta Câo*, from Fresno. Received August 31, 1891, in good condition. The must showed 22.4% of solid contents by spindle and 0.55% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 81°, on the third day. On the fourth day it was drawn off, and on the fifth day fortified.

At four months the wine was clear, of good flavor, but slightly bitter; it was of poor color and too dry. A month later it was racked, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At fourteen months it was racked again. At three years it was very much reduced by evaporation, on account of the thinness of the keg; it was not quite clear, but possessed good flavor and aroma and the right amount of sweetness. It was a good Port, but rather coarse and with a slight bitterness. Fourteen months later it had improved and was a Port of marked character, not very delicate, but excellent as a blend to give character to more neutral wines.

No. 1546. *Tinta Câo*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition, and mature. The bunches were very small; the berries also very small and seedy. The must showed 22.7% of solid contents by spindle and 0.38% of acid.

No. 1568. *Tinta Câo*, from Mission San José. Received October 9, 1891, in good condition, and mature. The must showed 21.1% of solid contents by spindle and 0.78% of acid. The temperature of the grapes at crushing was 60°, and the maximum reached was 84°, on the fourth day. On the fifth day the wine was drawn off, and on the sixth fortified.

At three months the wine was clear, but tasted too acid and was too dry. A month later it was racked, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At one year it was racked for the third time. At three years the wine was in good order, but was a thin, poor wine, with very little Port character; on account of the small quantity, it was put in a demijohn. Fourteen months later it had improved, and had developed some bouquet. It was rather thin, but was otherwise a good Port.

No. 1697. *Tinta Câo*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 22.4% of solid contents by spindle and 0.45% of acid.

No. 1732. *Tinta Câo*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 23.5% of solid contents by spindle and 0.50% of acid.

No. 1769. *Tinta Câo*, from Mission San José. Received October 15, 1892, in good condition. The must showed 22.8% of solid contents by spindle and 0.97% of acid. The temperature of the grapes at crushing was 58°, and the maximum reached was 80°, on the fourth day. On the fifth day the wine was drawn off and fortified.

The wine was clear at three weeks after pressing, and was racked at one month. At two months it was bright and clean-tasting, but too dry and with little Port character. It was racked again, and two months later sweetened and refortified. At twelve months it was racked again and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. A year later it was sound and in good order, but was not an agreeable wine; it was too acid and rough, and had little of the Port character. Thirteen months later it had improved, was of good color, and had developed some bouquet; it was, however, much less marked in character than the Tinta Câo from Tulare.

No. 1772. A blend was made of the grapes of Nos. 1769, 1770, and 1771, in the proportions of Tinta Câo, 21.4%; Tinta Amarella, 57.2%; Tinta Madeira, 21.4%. The temperature of the grapes at crushing was 58°, and the maximum reached was 92°, on the fifth day. The wine was dry on the sixth day, and was drawn off.

At three weeks the wine was quite dry and nearly clear. It was racked, and in three months was bright, of good flavor and some bouquet, fresh-tasting, with full acid and medium astringency. Three months later it was racked again, being in good condition and improved in character. At eight months it was in good order, and showed excellent promise. Two months later it still tasted a little raw, but was of good bouquet and clean-tasting. At four months it had improved, but was not mature. At eighteen months it was bottled. Twenty months after bottling the wine was bright, without deposit, good, sound, and of neutral character, of good color, acid, and astringency. A good table wine, but not of high quality.

No. 1849. *Tinta Câo*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches were small and loose; the berries small and not quite mature. The must showed 20.6% of solid contents by spindle and 0.79% of acid.

No. 1920. *Tinta Câo*, from Paso Robles station. Received October 12, 1893, in good condition. The bunches were small and rather loose, no coulure; the berries small, round, well-colored, fleshy, mature. The must showed 24.6% of solid contents by spindle and 0.56% of acid. The temperature of the grapes at crushing was 69°, and they were fermented for four days, when they were pressed and the wine fortified while still a little sweet.

At two months the wine was bright and a little too dry. It was racked at this date, and again six months later, when it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. It was racked a week after taking from the heating-chamber. At twenty-seven months it was bright, of full Port flavor, but still rough and undeveloped.

No. 1975. *Tinta Câo*, from Tulare station. A sample for must analysis was received October 16, 1893, in good condition. The bunches were very small, loose, shortly conical; berries very small, round, thick-skinned, mature, except for some second-crop bunches. The must showed 22.6% of solid contents by spindle and 0.71% of acid.

No. 2051. *Tinta Câo*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition, mature, and very sweet. The bunches were small, branching, and well filled; the berries small, firm, and juicy. The must showed 24.6% of solid contents by spindle and 0.72% of acid.

MOURISCO PRETO.

(See Vit. Rept. 1883–85, p. 140; 1887–89, p. 265.)

Synonyms: Mourisco tinto do Douro; Nova Rei.

Description.—Trunk vigorous, with thick and but slightly adherent bark, which is not much ribboned. The growth starts regularly after the middle of March; the young shoots are but slightly pubescent and of a light color. The canes are strongly inclined, short, with internodes averaging about 3, but occasionally as much as 4¾ inches; nodes small and somewhat flattened. Color of bark, light brown and uniform; wood hard, with little pith. Leaves large, of uniform size, almost round; some five-lobed, with the lateral sinuses but slightly open, while the basal one is widely open; margin with large but rather obtuse teeth. The upper surface of the leaf is smooth, glabrous, brightly and uniformly green; the lower surface is a little rough, hardly pubescent, pale green, and the principal veins strongly marked. Petiole medium length, thick, smooth, whitish-green. Bunches numerous, mostly large, sometimes very large, pyramidal in form, more or less branched; peduncle large, thick, rather soft, light or yellowish green. Berries large, almost uniform in size, regular, flattened, and umbilicate, dull black, adhering strongly to the pedicels, which are long and nearly smooth; flesh quite firm, skin thick, juice sweet and very agreeable. It yields about 55% of juice. It matures late in the second period.

The Mourisco preto was for a time considered as resistant to the attacks of phylloxera, but, like the Flame Tokay, it soon proved to be only partially and insufficiently so. It is a very vigorous, healthy vine, and one of the most promising Port varieties so far tested in California. It bears well and produces a good Port, both at Tulare and Paso Robles, being for this purpose superior to the Tinta Amarella. It attains a good amount of sugar, and is marked by low acid and low tannin. It is quite unsuited for dry wines, but the composition of the must and the general character of the grape render it eminently fitted for Port.

ANALYSES OF MUSTS AND WINES.

MOURISCO PRETO.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
						By Weight	By Volume		At Pressing	At Six Months		
1892—No. 1674. Tulare	Sept. 20	22.40	22.67	.32	.39	14.55	17.92	.083	.41	......	3.61	1.75
1893—No. 1923. Paso Robles	Oct. 10	25.40	24.12	.47	.42	9.20	11.45	......	.50	.41	2.30	......
No. 1968. Tulare	Oct. 14	23.90	23.13	.47	.56	......	18.30	.066	.45	.49	3.26	.34
1894—No. 2185. Amador station	Sept. 24	25.20	......	.44	......	......	......	......	......	......	......	......
No. 2321. Tulare	Oct. 15	25.00	......	.54	......	......	......	......	......	......	......	......

RECORD OF TREATMENT.

No. 1674. *Mourisco preto*, from Tulare station. Received September 21, 1892, in good condition, and mature. The must showed 22.4% of solid contents by spindle and 0.32% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 82°, on the third day. The wine was drawn off on the fifth day, while still a little sweet, and fortified.

In six weeks the wine was clear, and in two months bright. It showed a good Port flavor, but was rather too dry. At five months it was sweetened, refortified, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. A month after taking from the heating-chamber it was in good condition, of good flavor and very decided Port aroma. It made an excellent blend with one half Tinta de Madeira. When the wine was two years old it was in good condition, a somewhat coarse, heavy-flavored Port, requiring blending with a neutral or more delicate wine. Thirteen months later it had improved, was of good color, had become smoother, and developed a good bouquet.

No. 1923. *Mourisco preto*, from Paso Robles station. Received October 12, 1893, in good condition, quite mature, but not shriveled. The bunches were small, irregular, rather loose; the berries small, round, fleshy, with little juice. The must showed 25.4% of solid contents by spindle and 0.47% of acid. The grapes were crushed at a temperature of 69°, and fermented for four days, when they were fortified while still a little sweet.

In one month the wine was bright, but was rather too dry. At five months it was racked for the second time, and placed in the heating-chamber, at a temperature of from 90° to 95°, for three months. It was racked again two months after taking from the heating-chamber. At twenty-seven months it was not bright, was rough, and still tasted raw; it was of poor color, but had a good and full Port aroma.

No. 1968. *Mourisco preto*, from Tulare station. Received October 16, 1893, in good condition, but some were not quite mature. The bunches were conical, shouldered, and loose; the berries of medium size and nearly round. The must showed 23.9% of solid contents by spindle and 0.47% of acid. The grapes were crushed at a temperature of 68°, and reached a maximum of 78° on the second day. On the third day the wine was drawn off, and on the fifth day was fortified.

At one month the wine was racked; it was bright and too dry. At eight months it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months At eleven months it was racked for the third time. At twenty-seven months it was bright, of poor color, too dry and still raw, but of full Port aroma and promising.

MISSION.

Description.—Vine vigorous and a heavy grower; leaves of medium size, shiny green and glabrous above, downy below, barely lobed, acutely toothed, on reddish petioles; bunches large, pyramidal, spreading, loose; berries of medium size, round, crisp, brownish-red.

The suggestion of Mr. Charles A. Wetmore that the Mission is the same as the Monica, the most valued grape of Sardinia, is interesting, but we believe not quite correct. The Monica has been cultivated at the Experiment Stations for four years, but has only fruited once. It can be distinguished at first glance from the Mission by the yellowish-green of its foliage and the decided pink of the tips of the growing shoots. The young leaves are more deeply bronzed, and the older leaves are more densely woolly (tomentose) below, and lose the down of the upper surface more slowly. The grapes as grown at Tulare are much larger, finer, and of more agreeable flavor than those of the Mission grape. With these exceptions there is certainly a very close resemblance between the varieties, which shows that they are very closely connected. It is possible that years of cultivation and unconscious selection in California may be the cause of the differences, but we think it more probable that the Mission is a seedling of the Monica. There is little to be said in favor of our old, rejected friend, the Mission, except that it may still be useful in some localities as an ingredient in Sherries. Its total lack of character and low acid render it unfit for any other purpose than blending where a neutral ingredient is desired.

ANALYSES OF MUSTS AND WINES.

MISSION.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body	Sugar
						By Weight	By Volume		At Pressing	At Six Months		
1890—No. 1256. Amador station	Sept. 23	22.20	......	.44	.31	9.56	11.91	.168	.40	.38	2.52	......
1892—No. 1692. Tulare	Sept. 26	25.90	......	.38	......	......	......	......	......	......	......	......
No. 1720. Paso Robles	Oct. 10	23.25	23.13	.42	......	16.31	20.06	......	.37	......	2.57	2.23
1893—No. 1870. Amador station	Sept. 12	20.40	......	.48	......	......	......	.154	.68	......	......	......
No. 1978. Tulare	Oct. 19	26.30	25.53	.38	.57	8.98	11.18	- --	.39	.42	2.45	......

COLOR READINGS.

MISSION.	At Pressing.		One Month.		Two Months.		Three Months.
1890—No. 1256. Amador station	11.1	VR+2Y	4.8	3R+2Y	4.9	1R+2Y	*
1893—No. 1870. Amador station	12.3	1VR+1Y	10.7	2VR+1Y	......	......	......

*Too light for instrument.

RECORD OF TREATMENT.

No. 1256. *Mission*, from Amador station. Received September 26, 1890, in good condition. The bunches were of medium size, pyramidal and loose, with small shoulders; berries medium to small, round, not quite mature. The must showed 22.2% of solid contents by spindle and 0.44% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 77°, on the fifth day. On the seventh day the wine was drawn off, though it was still very sweet.

Three weeks after pressing it showed no signs of fermentation, but was still turbid and contained 3% or 4% of sugar. A month later it was still cloudy, and the lees were full of elongated yeast cells, but no unsound germs were observed. The wine was without color, nearly dry, tasteless, and flat. It was racked, and a month later the lees showed unsound germs. The taste of the wine was not affected. It was cloudy, but quite dry and improved in taste. It was pasteurized, but did not improve, and four months later it was cloudy, coarse, and insipid. After this it became gradually worse, and never became quite clear.

No. 1692. *Mission*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 25.9% of solid contents by spindle and 0.38% of acid.

No. 1720. *Mission*, from Paso Robles station. Received October 13, 1892, in good condition. The must showed 23.25% of solid contents by spindle and 0.42% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 74°, on the fourth day. The wine was drawn off on the fourth day and fortified.

At one month the wine was clear, and was racked. At ten weeks it was bright, and was racked; it was clean-tasting, but too sweet. Two months later it was refortified. When twelve months old it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years it was in good order; it was a fair Sherry, but too sweet and without much character. Thirteen months later it had improved very much; it was a good, clean-tasting Sherry, rather too sweet, and without much aroma, but very pleasing.

No. 1870. *Mission*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches were large and loose; the berries uneven in size and degree of ripeness. The must showed 20.4% of solid contents by spindle and 0.48% of acid.

ALEATICO.

Synonym: Uva liatica.

Description.—Vine fairly vigorous and productive in warm locations; leaves longer than wide, glabrous on both sides, irregularly and sharply dentate, the upper sinuses well marked, the lower shallow or absent, on reddish petioles; bunches over medium size, winged, compact when not coulured, on thick peduncles; berries of medium size, round, crisp, and juicy, on thick pedicels; skin reddish-purple, tough. The grapes have a very delicate and agreeable Muscat flavor.

The finest red "vins de liqueur" of Tuscany and Piedmont are made from this variety. It is often blended with other varieties for this purpose, but even when used alone its Muscat flavor is delicate and agreeable. The wine has a fuller astringency than that of other black Muscats, which takes away the somewhat nauseating effect characteristic of many Muscat wines. The vine bears well and ripens its crop early at Tulare, where, however, the grapes easily dry up if not gathered in time. The grapes attain a high percentage of sugar in all localities tested, and maintain their acid well. The grapes from Tulare, which are the only ones which have been tested for wine, make an agreeable and delicate "vin de liqueur."

Analyses of Musts and Wines.

ALEATICO.		Date of Picking	MUST.				WINE.						
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At Six Months	Body	Sugar
1890—No. 1368.	Cupertino	Oct. 14	29.50		.74								
1891—No. 1548.	Paso Robles	Oct. 6	24.70		.44								
1892—No. 1631.	Tulare	Sept. 3	27.80	27.13	.41	.48	14.91	18.36		.42	.52	5.80	2.40
No. 1724.	Paso Robles	Oct. 10	25.75		.50								
1893—No. 1796.	Tulare	Aug. 29	24.35	23.13	.75	.30	13.86	17.92		.54		6.70	4.00
No. 1851.	Amador station	Sept. 13	22.20	20.99	.63	.26	13.34	17.08	.125	.59	.62	4.15	1.41
No. 1933.	Paso Robles	Oct. 12	26.60	26.31	.53	.31			.311				
No. 2133.	Cupertino	Nov. 5	30.00		.62				.266				
1894—No. 2148.	Tulare	Sept. 11	24.40		.60								

Color Readings.

ALEATICO.		At Pressing.		One Month.		Two Months.		Three Months.	
1892—No. 1631.	Tulare	11.4	VR+Y	4.6	VR+2Y				
1893—No. 1851.	Amador station	20.8	5VR	16.0	VR+Y	9.8	YY	8.7	YY
No. 1983.	Paso Robles	11.8	3R						
No. 2133.	Cupertino	72.8	2VR						

Record of Treatment.

No. 1368. *Aleatico*, from Cupertino. A sample for must analysis arrived October 17, 1890, in fair condition. The grapes were somewhat overripe and shriveled; the bunches were of average size, conical, winged, loose, on thick, woody peduncles; the berries round, of medium size, on short but strong pedicels, skin tough, flesh crisp and juicy. The must showed 29.5% of solid contents by spindle and 0.74% of acid.

No. 1548. *Aleatico*, from Paso Robles station. A sample for must analysis arrived October 18, 1891, in good condition. The bunches were of medium size, well filled with fair-sized berries; the latter highly flavored and mature. The must showed 24.7% of solid contents by spindle and 0.44% of acid.

No. 1631. *Aleatico*, from Tulare station. Received September 6, 1892, in good condition but commencing to dry up. The must showed 27.8% of solid contents by spindle and 0.41% of acid. The grapes were crushed at a temperature of 69°, and reached a maximum of 81° on the third day. The wine was drawn off on the fourth day while still fermenting and very sweet, and was fortified on the fifth day.

In two weeks after pressing the wine was clear, and was racked. At three months it was racked for the second time; it was bright, of fair quality, and with slightly Muscat aroma. Three months later it was sweetened and fortified a little more; it was then put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At seven months it had not shown much development. At two years it had improved, and was a very good red sweet wine, of delicate Muscat aroma and clean taste. Eleven months later it had improved, was bright and very smooth and agreeable.

No. 1724. *Aleatico*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The berries were rather large for this variety. The must showed 25.75% of solid contents by spindle and 0.50% of acid.

No. 1796. *Aleatico*, from Tulare station. Received August 31, 1893, in fair condition. The bunches were over medium in size, rather compact. The grapes, which were of slightly Muscat flavor, were crushed for white wine. The must showed 24.35% of solid contents by spindle and 0.75% of acid. The temperature of the must at crushing was 63°, and the maximum reached was 84°, on the fifth day. On the fifth day, when the wine was still a little sweet, it was fortified.

At three months the wine was bright, well flavored, and very sweet. It was racked, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At one year it was racked for the third time. At two years and five months it was bright, of delicate and pleasing Muscat aroma and golden color; a very good "vin de liqueur."

No. 1851. *Aleatico*, from Amador station. Received September 15, 1893, in good condition. The must showed 22.2% of solid contents by spindle and 0.63% of acid. The grapes were crushed, and fermented in the heating-chamber, at a temperature of from 80° to 85°, for five days, when the wine was drawn off and fortified.

At three months the wine was bright and of sufficient sweetness; it was racked and put in the heating-chamber for three months, at a temperature of from 90° to 95°. At eleven months it was racked for the second time. At twenty-seven months it was not quite clear, of agreeable but not marked Muscat aroma, good, clean taste, but rougher and less developed than the Aleatico from Tulare.

No. 1933. *Aleatico*, from Paso Robles station. A sample for must analysis was received October 13, 1893, in fair condition. The bunches were loose, straggling, much coulured and sunburned; the berries irregular in size, of good flavor, and mature. The must showed 26.6% of solid contents by spindle and 0.53% of acid.

No. 2133. *Aleatico*, from Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, conical, close; the berries mostly dried up to raisins. The must showed 30.0% of solid contents by spindle and 0.62% of acid.

MOSCATELLO FINO.

Synonym: Moscatello nero.

Description.—Leaves of medium size, with deep upper and shallow lower sinuses, glabrous above, slightly downy below, and very hairy on the veins, teeth long and sharp; bunches large to very large, long, loose, conico-cylindrical, and winged; berries very large, on long, thin pedicels; skin well colored, thin but tough; flesh soft and juicy, with delicate Muscat aroma.

This variety is of excellent promise as a table-grape. It is a heavy bearer, and produces very fine-looking bunches of dark-colored grapes. It is rather late in bearing, and does not stand the weather very well.

ANALYSES OF MUSTS AND WINES.

MOSCATELLO FINO.	No. 1310. Cupertino.	No. 1919. Tulare.
Date of picking	Oct. 8, 1890	Oct. 7, 1893
Must.		
Solid contents by spindle	21.70	23.30
Acid as tartaric	.63	.53
Ash	.24	.40
Wine.		
Alcohol by weight	14.09	16.08
Alcohol by volume	17.37	19.78
Acid at pressing	.60	.59
Acid at six months	.50	.43
Tannin	.157	.131
Body	3.54	4.20
Sugar	.47	1.37

RECORD OF TREATMENT.

No. 1310. *Moscatello fino*, from Cupertino. Received October 10, 1890, in good condition, except for a few bunches which had commenced to mold. The bunches were large, long, loose, winged, on long, thin, tough peduncles; the berries were very large, but irregular in size, slightly oval, on long, thin pedicels; the skin was thin, black, and rather tough; the flesh soft and juicy. The grapes were mature, and the must showed 21.7% of solid contents by spindle and 0.63% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 81°, on the third day. On the third day the wine was drawn off and fortified.

At three months the wine was bright, of agreeable Muscat aroma and flavor, sweetness and alcoholic strength adequate. A week later it was racked and put in the heating-chamber, at a temperature of 100°, for three months. At eight months the wine was not in very good condition, but showed very good flavor. It was racked for the third time, and at sixteen months was clear, with strong and pleasing aroma, but too low in body and too high in acid. It was racked again at this time, but had deteriorated. At two years the wine showed some good qualities, but was rather thin. At this date it was put in glass.

No. 1919. *Moscatello fino*, from Tulare station. Received October 9, 1893, in good condition. The bunches were very irregular and varying in size, well filled, but not compact; the berries uneven in size, varying from very large to medium. The coloring was uneven, some berries being dark-colored, firm, crisp, and well flavored, others light-colored, soft, and flat-tasting. The must showed 23.3% of solid contents by spindle. The temperature of the grapes at crushing was 67°, and the maximum reached was 82°, on the second day. On the third day the wine was drawn off and fortified.

At two months the wine was bright and agreeable; it was racked for the second time, and put in the heating-chamber, at a temperature of 95°, for three months. At nine months it was racked again. At two years and a half the wine was in good condition; it was well developed, of light rose color, delicate Muscat flavor and aroma, clean-tasting, but rather light-bodied.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF PORT TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.*		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Tannin	Acid at Pressing	Acid at Six Months
	Tinta de Madeira.								
1247	Fresno	1890	24.80	24.22	.50	.43	.128	.45	.38
1459	Fresno	1891	24.80	......	.57	......	.225	.53	.47
1363	Cupertino	1890	27.45	......	.54	.35	.164	.56	.53
2056	Cupertino	1893	24.80	......	.56	......	.320	......	......
1301	Mission San José	1890	23.70	......	.52	.30	.241	.53	.38
1567	Mission San José	1891	24.53	......	.48	......	.270	.65	.43
1771	Mission San José	1892	23.05	22.67	.56	......	.136	.63	.50
2072	Mission San José	1893	26.30	25.76	.44	.27	......	......	......
2255	Mission San José	1894	22.60	......	.44	......	.237	......	......
1487	Paso Robles	1891	21.50	......	.48	......	......	......	......
1651	Paso Robles	1892	25.86	......	.59	......	......	......	......
1896	Paso Robles	1893	26.70	26.31	.39	.37	.115	.38	.41
1630	Tulare	1892	23.70	......	.42	......	.126	.50	.44
1977	Tulare	1893	24.40	......	.42	.40	......	.38	......
2337	Tulare	1894	25.90	......	.39	......	......	......	......
1850	Amador station	1893	23.90	21.38	.56	.33	.096	.56	.68
2146	Amador station	1894	26.50	......	.48	......	......	......	......
	Average, Fresno	......	**24.80**	**24.22**	**.53**	**.43**	**.176**	**.49**	**.43**
	Average, Cupertino	......	**26.12**	......	**.55**	**.35**	**.242**	**.56**	**.53**
	Average, Mission San Jose	......	**24.03**	**24.21**	**.48**	**.28**	**.221**	**.60**	**.43**
	Average, Paso Robles	......	**24.68**	**26.31**	**.73**	**.37**	**.115**	**.38**	**.41**
	Average, Tulare	......	**24.66**	......	**.40**	**.40**	**.126**	**.44**	**.44**
	Average, Amador station	......	**25.20**	**21.38**	**.52**	**.33**	**.096**	**.56**	**.68**
	Tinta Amarella.								
1388	Cupertino	1890	24.25	......	.72	......	.210	.60	.51
2059	Cupertino	1893	24.60	......	.65	......	.240	......	......
1340	Mission San José	1890	22.60	......	.81	.30	.107	.62	.44
1566	Mission San José	1891	23.05	......	.71	......	.206	.77	.49
1770	Mission San José	1892	21.80	21.38	.86	......	.170	.80	.61
2073	Mission San José	1893	23.30	21.80	.66	.31	.163	.68	.57
2308	Mission San José	1894	22.20	......	.62	......	......	......	......
1442	Tulare	1891	22.90	......	.51	......	......	......	......
1629	Tulare	1892	20.85	20.24	.64	.45	.093	.56	.53
1673	Tulare	1892	22.25	21.22	.60	.40	.096	.53	.44
1891	Tulare	1893	23.70	21.38	.41	.48	.106	.40	......
2291	Tulare	1894	24.00	23.13	.49	......	......	......	......
1457	Fresno	1891	23.70	23.13	.66	.42	......	.56	......
1486	Paso Robles	1891	21.50	......	.61	......	......	......	......
1753	Paso Robles	1892	22.00	......	.34	......	......	......	......
1897	Paso Robles	1893	23.70	23.61	.44	.37	.150	.56	.53
1878	Amador station	1893	18.20	......	.78	.33	......	.67	......
2181	Amador station	1894	23.90	23.13	.54	......	.089	......	......
	Average, Cupertino	......	**24.42**	......	**.68**	......	**.225**	**.60**	**.51**
	Average, Mission San Jose	......	**22.39**	**21.59**	**.73**	**.31**	**.162**	**.72**	**.53**
	Average, Tulare	......	**22.74**	**21.49**	**.53**	**.44**	**.098**	**.50**	**.49**
	Average, Paso Robles	......	**22.10**	**23.61**	**.46**	**.37**	**.150**	**.56**	**.53**
	Average, Amador station	......	**21.05**	**23.13**	**.66**	**.33**	**.089**	**.67**	......

SUMMARY OF ANALYSES OF MUSTS AND WINES OF PORT TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST. Solid Contents by Spindle	MUST. Sugar by Copper Test	MUST. Acid as Tartaric	MUST. Ash	WINE.* Tannin	WINE.* Acid at Pressing	WINE.* Acid at Six Months
	Tinta Cão.								
1371	Cupertino	1890	23.25	----	.52	----	----	----	----
2051	Cupertino	1893	24.60	----	.72	----	.246	----	----
1379	Mission San José	1890	23.07	----	1.03	.23	.222	----	.42
1568	Mission San José	1891	21.10	----	.78	----	.210	.75	.50
1769	Mission San José	1892	22.80	21.80	.97	----	.120	.82	.60
2275	Mission San José	1894	20.20	----	.71	----	.166	.65	----
1467	Fresno	1891	22.40	21.80	.55	.60	.095	----	.18
1546	Paso Robles	1891	22.70	----	.38	----	----	----	----
1732	Paso Robles	1892	23.50	----	.50	----	----	----	----
1920	Paso Robles	1893	24.60	23.61	.56	.34	.100	.52	.69
1697	Tulare	1892	22.40	----	.45	----	----	----	----
1975	Tulare	1893	22.60	----	.71	----	.413	.69	----
2338	Tulare	1894	26.50	----	.40	----	----	----	----
1849	Amador station	1893	20.60	19.41	.79	.30	----	.55	----
2167	Amador station	1894	25.40	23.61	.48	----	----	.48	----
	Average, Cupertino	----	**23.92**	----	**.62**	----	**.246**	----	----
	Average, Mission San Jose	----	**21.79**	**21.80**	**.80**	**.23**	**.180**	**.74**	**.51**
	Average, Paso Robles	----	**23.60**	**23.61**	**.48**	**.34**	**.100**	**.52**	**.69**
	Average, Tulare	----	**23.83**	----	**.52**	----	**.413**	**.69**	----
	Average, Amador station	----	**23.00**	**21.51**	**.63**	**.30**	----	**.52**	----
	Mourisco preto.								
1674	Tulare	1892	22.40	22.67	.32	.39	.083	.41	----
1968	Tulare	1893	23.90	23.13	.47	.56	.066	.45	.49
2321	Tulare	1894	25.00	----	.54	----	----	----	----
1923	Paso Robles	1893	25.40	24.12	.47	.42	----	.50	.41
2185	Amador station	1894	25.20	----	.44	----	----	----	----
	Average, Tulare	----	**23.76**	**22.90**	**.44**	**.47**	----	----	----
	Mission.								
1720	Paso Robles	1892	23.25	23.13	.42	----	----	.37	----
1692	Tulare	1892	25.90	----	.38	----	----	----	----
1978	Tulare	1893	26.30	25.53	.38	.57	----	.39	.42
1256	Amador station	1890	22.20	----	.44	.31	.168	.40	.38
1870	Amador station	1893	20.40	----	.48	----	.154	.68	----
	Average, Tulare	----	**26.10**	**25.53**	**.38**	**.57**	**.074**	**.43**	**.49**
	Average, Amador station	----	**21.30**	----	**.46**	**.31**	----	----	----
	Aleatico.								
1368	Cupertino	1890	29.40	----	.74	----	----	----	----
2133	Cupertino	1893	30.00	----	.62	----	.266	----	----
1548	Paso Robles	1891	24.70	----	.44	----	----	----	----
1724	Paso Robles	1892	25.75	----	.50	----	----	----	----
1933	Paso Robles	1893	26.60	26.31	.53	.31	.311	----	----
1631	Tulare	1892	27.80	27.13	.41	.48	----	.42	.52
1796	Tulare	1893	24.35	23.13	.75	.30	----	.54	----
2148	Tulare	1894	24.40	----	.60	----	----	----	----
1851	Amador station	1893	22.20	20.99	.63	.26	.125	.59	.62
	Average, Cupertino	----	**29.70**	----	**.68**	----	**.266**	----	----
	Average, Paso Robles	----	**25.68**	**26.31**	**.49**	**.31**	**.311**	----	----
	Average, Tulare	----	**25.51**	**25.13**	**.58**	**.39**	----	**.48**	**.52**
	Moscatello fino.								
1310	Cupertino	1890	21.70	----	.63	.24	----	----	----
1919	Tulare	1893	23.30	----	.53	.40	----	----	----

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* Fortified.

SHERRY TYPE.

It is perhaps incorrect to speak of "California Sherries," for little or no wine of the true Sherry type is made in California. The celebrated wines of Jerez, except for limited quantities of "vinos dulces," are almost or quite dry, and made by processes essentially different from those practiced in California. The finest Spanish Sherries are fortified to a very limited extent, and contain only from 13% to 15% of alcohol after fortifying. They are made from very ripe or slightly dried grapes, which are crushed, fermented for two or three months, and racked before the addition of alcohol. Often a little "vino dulce," or sweet wine, is added later—enough to destroy any harshness, but not enough to cause the wine to be classed properly as "sweet." Sherries, so called, as made in California, are, on the contrary, always sweet and in general *very* sweet. They would more properly be called Sweet Madeira, the type to which they most closely approach. They are, in fact, what the French call sweet "vins de liqueur," of which an almost infinite variety is made in various vine-growing parts of the world. All these "vins de liqueur," though exhibiting a wonderful variety of qualities, have certain characteristics in common. They all possess low acidity, have more or less of a peculiar taste known as the "rancio," "gout de rance," and sometimes improperly as the "Sherry taste," and generally contain a certain quantity of unfermented sugar and a high percentage of alcohol.

The cause of this "rancio" taste has been the subject of much controversy and experiment. The tendency to impute all changes in wine to the action of some micro-organism led to the belief that the action of some ferment was responsible for the production of this taste in wines. It has now, however, been conclusively proved that it is due simply to chemical oxidation of the sugar and other organic constituents of the wine, without the presence, necessarily, of any living organism. Wines and syrups have been caused to acquire the "rancio" taste while being kept perfectly sterilized by the most careful precautions. It is, therefore, incorrect to call this the "Sherry taste," as it is common to many wines besides those of Jerez. The characteristic flavors of these, which could properly be called the "Sherry taste," are due to peculiarities of soil, variety of grape, and processes of manufacture, and can only be approximated outside of the Jerez district, while the "rancio" taste can be given to almost any wine in any locality by appropriate methods.

For the production of good "vin de liqueur" two qualities are essential in the grapes: they must be high in sugar and very low in acid. These conditions are constantly possible only in hot localities and with certain varieties of grapes. The great valley of California and the Sierra foothills are especially adapted to the production of these wines, and with proper varieties (the grapes of Andalusia, especially) excellent results can be and have been obtained. For the best results the must should show at least 24% of solid contents by spindle, and should not exceed 4 pro mille of acid. With the right varieties and proper treatment of the vines these conditions can perhaps always be fulfilled over a large part of California, without the trouble and expense of resorting to the European practice of exposing the gathered grapes to a partial evaporation in the sun before crushing. For the production of the commoner grades the addition of de-acidified grape syrup is the simplest and best method of increasing the sugar contents to the requisite standard. The fermentation should be carefully watched, in order that the wine may be racked and fortified with the desired amount of sugar, and before any danger of secondary fermentation arises. The oxidation and the acquirement of "rancio" are governed by time, temperature, and access of air. The higher the temperature and the fuller the access of air, the more rapidly does the wine acquire this taste. Within certain limits, however, the slower the oxidation the more delicate the resulting flavors. The common practice of heating the wine to a very high temperature for a short time cannot produce high-class wines. The best method is to mature the wine in a warm cellar, or heat for several months at a temperature not exceeding 100° F.

The Palomino, Pedro Jimenes, Perruno, Mourisco branco, and Mantuo de Pilas have all grown well, given good crops, and produced good wine in the lower San Joaquin Valley. They are much improved, however, by an addition of Verdelho or Boal, which bear much less, but possess higher quality and more pronounced flavor. A mixture, therefore, of two thirds of one or two varieties of the former group, with one third of Verdelho or Boal seems at present to be the best choice of varieties that can be made in that district for the production of sweet wines. Grenache and Mission have also given good results where they do not attain too much color, and could doubtless be well used to blend with the others, especially with the addition of a little Verdelho.

The Malmsey is also very promising as a variety to be used in small quantities to give character. It has a delicate aroma—that of the true Malvoisies—resembling Muscat, but more delicate and more suitable for sweet wines.

The Doradillo, one of the most esteemed grapes of Malaga and Granada, has been tried to a limited extent at the Eisen vineyard at Fresno, and has proved a strong grower and heavy bearer. It has apparently all the requisites for the making of a good sweet wine, but has not yet been thoroughly tested.

The Furmint, or true Tokay grape, has been tried at the same vineyard, and has produced some good wine, but it would probably give better results in the foothills.

The only varieties which seem at all promising for the production of sweet wines in the cooler localities are the Palomino and the Verdelho. These varieties make an excellent blend, but as the Palomino ripens later than the Verdelho, the blending should be done at the first racking. Whether dry wines of the true Jerez type can be produced in California cannot be definitely settled without considerable further experiment.

PEDRO JIMENES.

(See Vit. Rept. 1883–85, p. 130; 1885–86, p. 105.)

Synonyms: Pero Ximenes; Pedro Ximenez.

The Pedro Jimenes is the principal wine-grape of Malaga, Granada, and Motril; it is also cultivated to a more limited extent in Jerez and Pajarete. It is chiefly famous as the grape from which the widely known Pero Jimenes wine is made. It is also used in conjunction with the Palomino in the manufacture of dry Sherries, and occasionally with the Tintas for the manufacture of red wines. It has been introduced with great success into the Crimea and Algeria, and less successfully into the south of France. Clemente describes and figures two varieties under this name, one of which he calls the typical Pedro Ximenez, and the other the Ximenez Zumbon. They differ considerably in size of berries and fertility of the vines, but are, according to Mas and Pulliat, simple variations obtained by selection of cuttings.

Description.—Vine vigorous and productive, with slender, short-jointed canes; leaves of medium size, with shallow, narrow sinuses, teeth blunt and short, upper surface glabrous, the lower surface at first covered with a little close wool, becoming glabrous, veins light yellow; bunches very large, branching, loose, but well filled, berries very large, slightly oval, firm, fleshy, and of golden-yellow color.

The above description is taken from vines as they are growing at the Experiment Stations, and differs in several respects from the description of this variety in European works. The grapes as they grow here are much larger, ripen later, and do not attain the extremely high sugar contents with which the Pedro Jimenes is credited in Andalusia. It is somewhat doubtful, therefore, if we have the real Pedro Jimenes here, but a new importation made by the Agricultural Experiment Station this year will probably settle the question. The average must composition of this variety has been: at Mission San José and Cupertino, 21.8% of sugar and 0.42% of acid; at Fresno and Tulare, 22.7% of sugar and 0.38% of acid; at Paso Robles, 21.5% of sugar and 0.45% of acid. The figures for Amador are not given, as the grapes were gathered there before they were mature. These figures show that this variety fails to attain as large an amount of sugar as the Palomino, and shows a little more acid. It ripens late, and is certainly not to be recommended for the cooler localities. In the hotter valleys it has so far not equaled the Palomino either in chemical composition or in quality, and for the making of Sherries cannot at present be said to have shown any advantages over that variety. It makes a neutral, dry wine, of very light body, which may be useful in blending and for the manufacture of champagne wines.

It may find a place as a table-grape, as its magnificent bunches and berries are not exceeded in beauty by any white variety, and their firmness makes it more suitable for shipping purposes than the Verdal. The vine requires a rich soil and short-pruning to maintain its fertility. As a variety for dry white wine the Pedro Jimenes has shown some good qualities at Tulare. It requires, however, the addition of some variety of higher aroma, such as the Malmsey (see No. 1900), and would also be improved by the addition of a more acid grape for this purpose.

It will be seen by the above account that the character of this grape, and of the wine made from it, is so different from what it is credited with in Spain that the discrepancy can hardly be accounted for by simple difference of conditions.

TABLE OF PRODUCTION.

PEDRO JIMENES.	Number of Vines....	Total Weight of Grapes, in lbs....	Average per Vine, in lbs.	Date of Picking.......
1887—No. 784 (long-pruned). J. T. Doyle, Cupertino....	20	146	7.3	Oct. 27
1888—No. 953 (long-pruned). J. T. Doyle, Cupertino....	19	140	7.3	Nov. 6
1889—No. 1191. J. T. Doyle, Cupertino..................	16	120	7.5	Oct. 17

SHERRY TYPE—PEDRO JIMENES.

PEDRO JIMENES.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash	Sugar
						By Weight	By Volume					
1884—No. 266. Natoma Wine Co., Natoma	......	20.78	20.61	.33	.40	9.63	12.00	.56	......	1.18	.39	......
1886—No. 484. Natoma Wine Co., Natoma	Sept. 20	19.30	18.89	.38	.35	7.78	9.73	.59	......	2.00	......	......
1887—No. 784. J. T. Doyle, Cupertino	Oct. 27	21.26	20.61	.45	.40	7.50	9.36	.68	.23	2.30	......	......
1888—No. 953. J. T. Doyle, Cupertino	Nov. 6	19.40	19.89	.35	.48	7.64	9.54	.36	......	2.40	......	......
1889—No. 1191. J. T. Doyle, Cupertino	Oct. 17	20.06	......	.25	.41	14.33*	17.70*	.21	......	4.00	......	......
1890—No. 1244. Margherita Vineyard, Fresno	Aug. 23	21.20	20.39	.41	.61	16.31*	20.06*	.30	......	2.77	....	5.15
No. 1352. J. Gallegos, Mission San José	Oct. 12	22.30	......	.42	......	14.08*	17.40*	.34	......	2.48	......	2.60
No. 1404. J. T. Doyle, Cupertino	Oct. 20	19.70	......	.47	.23	13.92*	17.20*	.33	......	2.08	......	traces
1891—No. 1502. Fresno	Sept. 22	23.70	23.13	.45	......	15.50*	19.08*	.30	......	2.61	.....	1.74
No. 1502a. Fresno	Sept. 22	23.70	23.13	.45	......	16.31*	20.06*	.27	......	......	......	......
No. 1606. Mission San José	Oct. 25	24.80	......	.49	.37	17.25*	21.19*	.20	......	3.31	......	.64
1892—No. 1670. Tulare	Sept. 17	22.60	21.38	.33	.47	14.82*	18.25*	.38	......	2.55	......	1.75
No. 1779. Mission San José	Oct. 13	23.15	22.67	.50	......	9.27	11.55	.53	......	2.60	......	......
1893—No. 1853. Amador station	Sept. 13	19.30	......	.53	......	......	......	......	......	......	......	......
No. 1900. Tulare	Sept. 27	22.20	21.80	.41	.43	8.48†	10.58†	.45	......	2.60	......	......
No. 1916. Paso Robles	Oct. 5	21.50	21.00	.40	.38	......	18.25*	.35	......	2.85	......	......
No. 2036. Cupertino	Oct. 30	23.70	......	.47	......	......	......	......	......	......	......	......
1894—No. 2164. Amador station	Sept. 17	21.50	......	.58	......	......	......	......	......	......	......	......
No. 2214. Paso Robles	Sept. 26	21.50	......	.49	......	......	......	......	......	......	......	......
No. 2246. Mission San José	Oct. 3	22.30	......	.42	......	......	......	......	......	......	......	......
No. 2350. Tulare	Oct. 27	23.90	......	.29	......	......	......	......	......	......	......	......

Record of Treatment.

No. 784. *Pedro Jimenes*, from Cupertino. Received October 28, 1887, in good condition, and crushed on the same day. A few bunches were compact, but they were generally loose and characteristically branched; the berries were large, sound, sweet, and with very little acid, a few were prematurely dried, and there was some coulure. The must showed 21.26% of solid contents by spindle and 0.45% of acid. The temperature of the grapes at crushing was 72°, and the maximum reached was 88°, on the second day. The yield of wine was 8.7 gals., being at the rate of 170 gals. per ton.

At two weeks, when the wine was racked, the odor was not good. A month later it was still cloudy, and had a flat and suspicious taste. An examination of the lees showed the presence of acetic ferment and some filaments. The wine was therefore racked and pasteurized. After this the wine did not improve, but continued to deteriorate until, at fourteen months, it was distilled.

No. 953. *Pedro Jimenes*, from Cupertino. Received November 8, 1888, in good condition. The bunches showed signs of coulure, and the berries were deficient in both acid and sugar. The 98.5 lbs. crushed yielded 7.8 gals. of wine, or at the rate of 160 gals. per ton. The temperature of the grapes at crushing was 67°, and the maximum reached was 84°, on the second day. The wine was dry on the eleventh day.

At two weeks the wine was drawn off, and two weeks later it was taken to the cellar. At two months it was clear and with fair aroma, but too low in alcohol and with a green taste. Two months later it was racked again and the lees examined. At nine months the wine was bright and had improved in bouquet and flavor; it tasted quite sound, and had developed rapidly. At thirteen months it was in good order, but some bottled at four months had not kept well. At fifteen months the lees were sound, and the wine was bright, and had developed a strong Sherry bouquet and flavor. Five months later it was still in good order, but the aroma had diminished and the wine tasted a little thin; the lees were quite sound, and a month later the wine was bottled. At two years and four months the wine bottled at four months was spoiled, but that bottled at twenty-one months was bright, delicately flavored and clean-tasting, but rather thin. At four years it had changed little, and was still bright and sound. At seven years it had deteriorated and tasted mousy.

No. 1191. *Pedro Jimenes*, from Cupertino. Received October 18, 1889, in fairly good condition, and was crushed on the same day. The grapes were extremely fine in appearance, the bunches very large and well filled with very large berries; they were, however, rather low in sugar. The must showed 20.06% of solid contents by spindle and 0.25% of acid. The 56 lbs. crushed yielded at the rate of 161 gals. per ton. The temperature of the grapes at crushing was 69°, and the maximum reached was 75°, on the third day. On the third day the fermentation was checked by the addition of a small quantity of spirits, and on the fifth day the fortifying was completed.

At three months the wine was clear, but was thin and insipid; only in the faint bouquet was there any suggestion of the high quality which the variety ought to show. Three days later it was racked and sweetened by the addition of rock-candy. At four months it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At seven months it was bright, clean-tasting, and much improved. It was racked again, and four months later showed little change. At twenty months it was bright, with pleasing but not marked flavor, of fair quality, but lacking in body and character. Eight months later it showed considerable improvement. At six years and four months it was in good condition, was smooth, agreeable, and mature, but with little aroma or flavor.

No. 1244. *Pedro Jimenes*, from Fresno. Received August 26, 1890, in good condition, but not quite mature. The must showed 21.2% of solid contents by spindle and 0.41% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 83°, on the third day. On the third day the wine was fortified.

At three months the wine was nearly clear, with less aroma and flavor than the Palomino from Fresno, but still very pleasing. The acidity was low, but there was too much sweetness. Two months later it was bright, with good, delicate aroma, less pronounced than the Palomino, but more delicate. The wine was racked, and put in the heating-chamber, at a temperature of 110°, for three months. At ten months it was in good order, with good Sherry aroma and flavor, but not of marked character. It was racked for the third time, and at seventeen months it was bright, clean-tasting, and agreeable, but too sweet. It was racked again, and at three years and ten months was still in good order. Four months later it was nearly mature, and was a good wine but for an excess of sweetness and a slight bitterness; it was put in glass. At five years and five months it was a good, clean-tasting Sherry, with rather more bouquet than the Palomino, but less marked "rancio" taste.

No. 1352. *Pedro Jimenes*, from Mission San José. Received October 14, 1890, in fair condition. The must showed 22.3% of solid contents by spindle and 0.42% of acid. The temperature of the grapes at crushing was 66°, and the maximum of 82° was reached on the third day. On the fourth day the wine was fortified while still a little sweet.

At three months the wine was bright, with faint aroma and fair flavor, rather too light, and the alcohol not well blended. A week later it was racked and put in the heating-chamber, at a temperature of 110°, for three months. At eight months it was bright and much improved in bouquet and flavor, clean-tasting, fruity, and well flavored. At this date it was racked. At sixteen months it was in very good condition, with good bouquet and flavor, rather low-bodied, but otherwise a good Sherry. After this the wine did not keep well, on account of the smallness of the keg.

No. 1404. *Pedro Jimenes*, from Cupertino. Received October 23, 1890, in good condition, but not quite mature. The ripening was irregular. The must showed 19.7% of solid contents by spindle and 0.47% of acid. The temperature at crushing was 66°, and the maximum reached was 82°, on the third day. It was fortified on the third day while still sweet.

At three months the wine was bright, but thin and vapid. It was racked, and two months later refortified. At seven months it was put in the heating-chamber, at a temperature of 105°, for three months. After this it did not improve, but remained a poor wine without quality. It was thin, flavorless, and unpleasing.

No. 1502. *Pedro Jimenes*, from Fresno. Received September 25, 1891, in good condition. The must showed 23.7% of solid contents by spindle and 0.45% of acid. The temperature of the must at crushing was 70°, and the maximum reached was 75°, on the third day. The fermentation was slow, and on the seventh day, when the wine was fortified, it was still sweet. Half of the must was used for a special fermentation, as follows: On the second day the must was fortified to 6% of alcohol; on the third day the maximum temperature of 78° was reached; on the fourth day 1% of alcohol was added. The fermentation continued slowly for fifteen days, when the fortifying was completed.

No. 1502 (ordinary fermentation). At four months the wine was full-flavored and rather too sweet. A month later it was racked for the second time, and at six months was put in the heating-chamber, at a temperature of from 90° to 95°. At two years and ten months it differed little from No. 1502*a*, but was, if anything, not quite so good. Four months later, when it was bottled, it was a little too sweet. At four years and five months the wine was clean-tasting, neutral, still immature, but promising.

No. 1502*a* (special fermentation). At four months the wine was bright, full-flavored, and of medium sweetness. A month later it was racked, and at six months was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months it was a very agreeable Sherry, with good bouquet and flavor of distinctive Sherry character, but not quite perfect in after-taste. Four months later it was bottled; it was very good, but had a slight bitterness. At four years and five months it differed little from No. 1502.

No. 1606. *Pedro Jimenes*, from Mission San José. Received October 28, 1891, in poor condition, many grapes being moldy. The temperature of the grapes at crushing was 68°, and the maximum reached was 81°, on the third day. The must showed 24.8% of solid contents by spindle and 0.49% of acid. The wine was fortified on the fourth day.

At three months the wine was clear, with full sweetness, but not much flavor. A month later it was racked, and at five months was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and nine months it was bright, of good, clean taste, agreeable aroma and flavor, but little Sherry character. Four months later it had improved, and was put in glass. At four years and four months it was a fair Sherry, with good flavor, but not mature, and lacking in delicacy of aroma.

No. 1670. *Pedro Jimenes*, from Tulare station. Received September 19, 1892, in good condition, and of good quality. The must showed 22.6% of solid contents by spindle and 0.33% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 77°, on the fourth day. The wine was fortified on the sixth day while still a little sweet.

The wine was clear at three weeks, and was racked. At three months it was bright and well flavored, but too dry. It was racked again, and at six months was refortified and sweetened. At thirteen months it was racked again, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years it was in good order, with full flavor and aroma, good body, sufficient sweetness and alcohol, altogether an agreeable Sherry, and maturing quickly. At three years and five months it was a very good Sherry, of clean taste, full aroma, and nearly mature.

No. 1779. *Pedro Jimenes*, from Mission San José. Received October 18, 1892, in good condition. The must showed 23.15% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 62°, and the maximum reached was 80°, on the third day. On the sixth day the wine was nearly dry, and on the seventh day it was racked off the thick lees.

In three weeks the wine was clear and perfectly dry. At one month it was racked and taken to the cellar. At three months it was bright, with some aroma, good flavor, medium acid, and good body; in general, very agreeable. Two months later it was in perfect condition, and was a good, clean-tasting wine. It was racked for the third time, and at eight months it had retained its good quality and was superior to No. 1780, Palomino. Tastings at ten and fourteen months showed gradual development and the acquirement of some bouquet. At fifteen months it was bottled. Two years after bottling it had made no deposit in the bottles, and was a good, neutral, clean-tasting wine, somewhat lacking in bouquet, but fully mature.

No. 1853. *Pedro Jimenes*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches were large and loose; the berries of good size, not mature. The must showed 19.3% of solid contents by spindle and 0.53% of acid.

No. 1900. *Pedro Jimenes*, from Tulare station. Received September 29, 1893, in good condition, but not quite mature. The bunches and berries were both large, and of very fine appearance. The must showed 22.2% of solid contents by spindle and 0.41% of acid. The grapes were mixed with No. 1901, Malmsey, from Tulare, in the proportion of 50 lbs. of the former to 72 lbs. of the latter. The temperature of the grapes at crushing was 66°, and the maximum reached was 78°, on the third day.

The wine was nearly dry on the fourth day. At one month it was clear, of good aroma and pleasing flavor, and was racked and taken to the cellar. At four months it was in good condition, with marked aroma and good body. A month later it was racked for the second time, and at seven months it was a wine of good character, fresh-tasting and pleasant. At eleven months it had developed well and retained its good qualities. At twelve months it was one of the best of the Tulare wines. At seventeen months it had changed little and was nearly mature. Three months later it was bottled. At two years and five months it was bright and without deposit in the bottles. It was very fresh and clean-tasting, and had developed a good bouquet. The Malmsey had given it a slight Muscat aroma.

No. 1916. *Pedro Jimenes*, from Paso Robles station. Received October 7, 1893, in good condition. The bunches were large, irregular, and loose; the berries over average in size, slightly oval and crisp. The grapes were quite mature. The must showed 21.5% of solid contents by spindle and 0.40% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 78°, on the third day. On the seventh day the wine was fortified while still sweet.

At two months the wine was bright, but flat and too dry. At eight months it was racked for the second time, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At eleven months it was racked again. At fourteen months it was in good order and much improved; its flavor and aroma were good, but it was too alcoholic. At two years and four months it was bright, still raw, but full flavored, clean-tasting, and promising.

No. 2036. *Pedro Jimenes*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition. The bunches were very large, conical, winged, loose; the berries varying from very large to very small in the same bunch, crisp, juicy, very sweet, and quite mature. The must showed 23.7% of solid contents by spindle and 0.47% of acid.

PALOMINO.

(See Vit. Rept. 1883–85, p. 131; 1885–86, p. 105.)

Synonyms: Listan; Temprano; Tempranilla; Golden Chasselas (California).

It is from this variety that the bulk of the Manzanillas and dry export Sherries of southwestern Spain are made. It is also used extensively in Malaga, both for wine-making and for the table. In Granada and other parts of southern Spain it is planted chiefly as a table-grape, for which purpose it is much esteemed. It is also used to a more limited extent for the production of the sweeter wines of Cadiz, but generally in connection with Pedro Jimenez or some other variety.

Description.—Vigorous in all fairly productive soils; leaves medium to large, five-lobed, upper sinuses wide at the base and often closed above, upper surface loose, woolly when young, soon becoming glabrous, lower surface densely and permanently white-woolly; bunches medium to large, irregular, loose; berries large, round, or flattened vertically, crisp, and fleshy.

The Palomino has established itself as a valuable grape for some parts of California. It has been used for the production of dry wine in some of the cooler localities, but not with great success. It is a good and regular bearer, but the wine in such localities is lacking in freshness and quality. The chemical composition of the must shows it to retain its European characteristics in California, and that it is essentially a Sherry or sweet-wine grape. It attains a high percentage of sugar even in the coast counties, is very regular in its ripening, and never exhibits excess of acid. The average composition of the must at Mission San

José and at Cupertino has been 22.6% of sugar and 0.41% of acid; at Fresno and Tulare, 23.9% of sugar and 0.29% of acid; at Paso Robles, 21.3% of sugar and 0.39% of acid; at Amador, 23.0% of sugar and 0.43% of acid. It cannot, therefore, be recommended for the production of light or dry wines in any locality, on account of its lack of acid and freshness. Of all the true Sherry grapes, however, it is the one which is most suited to the cooler localities. It ripens earlier and more regularly than the Pedro Jimenes and Mantuo, and makes a good, sweet Sherry, even in the coast counties. It has a distinctive natural aroma, which is lacking in most of the other Sherry grapes, but which decreases with age. As a grape for sweet wine or Sherry, it can be well recommended for any except the very late localities and those where the soil is too poor.

TABLE OF PRODUCTION.

PALOMINO.	Number of Vines	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking
1887—No. 765 (long-pruned). J. T. Doyle, Cupertino	20	106	5.3	Oct. 20
No. 698 (long-pruned). J. T. Doyle, Cupertino	20	378	18.9	Oct. 5
No. 728 (short-pruned). J. T. Doyle, Cupertino	20	232	11.6	Oct. 13
1888—No. 951. J. T. Doyle, Cupertino	18	218	12.1	Nov. 5
No. 952. J. T. Doyle, Cupertino	20	370	18.5	Nov. 5
1889—No. 1198. J. T. Doyle, Cupertino	16	175	10.9	Oct. 24

ANALYSES OF MUSTS AND WINES.

PALOMINO.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six Months	Volatile Acid at Six Months	Body	Ash	Sugar
1884—No. 267. Natoma Wine Company, Natoma	......	23.86	23.81	.32	.40	11.08	13.50	.53	......	1.85	.25	......
1885—No. 384.† L. D. Combe, San José	......			......	......	10.54	13.00	.57	......	2.18	.25	......
1886—No. 547. E. W. Hilgard, Mission San José	......	23.70	......	.55	......	......	......	......	......	......	......	......
No. 504. J. T. Doyle, Cupertino	Sept. 27	16.30	15.68	.53	.27	6.35	8.00	.59	......	1.55	......	......
1887—No. 727 (long-pruned). E. W. Hilgard, Mission San José	Oct. 10	22.00	20.85	.35	.40	8.91	11.09	.47	.02	2.40	......	......
No. 765 (long-pruned). J. T. Doyle, Cupertino	Oct. 20	23.09	22.67	.42	.44	9.78	12.18	.44	.05	2.60	......	......
No. 698 (long-pruned). J. T. Doyle, Cupertino	Oct. 5	19.57	19.75	.37	.38	7.50	9.36	.49	.06	2.10	......	......
No. 728 (short-pruned). J. T. Doyle, Cupertino	Oct. 13	23.30	22.67	.47	.37	9.70	12.09	.47	.05	2.60	......	......
No. 683. R. Wegener, Livermore	Sept. 13	22.60	22.58	.38	.40	9.12	11.36	.47	.05	2.40	......	......
1888—No. 952. J. T. Doyle, Cupertino	Nov. 5	21.57	22.67	.18	.36	8.77	10.91	.52	......	2.05	......	......
No. 951. J. T. Doyle, Cupertino	Nov. 5	21.39	21.80	.24	.34	8.27	10.36	.42	......	2.30	......	......
1889—No. 1041. Margherita Vineyard, Fresno	Sept. 2	25.00	25.19	.18	.65	*13.92	17.20	.44	......	2.35	......	5.20
No. 1171. J. Gallegos, Mission San José	Oct. 15	23.05	23.13	.38	.33	*15.58	19.00	.32	......	3.01	......	......
No. 1198. J. T. Doyle, Cupertino	Oct. 24	23.70	23.13	.22	.42	9.05	11.27	.39	......	1.95	......	......
1890—No. 1239. Margherita Vineyard, Fresno	Aug. 23	23.92	23.42	.34	.33	*14.82	18.25	.25	......	2.48	......	9.00
No. 1311. J. T. Doyle, Cupertino	Oct. 7	20.85		.43	.27	9.41	11.73	.38	......	2.10	......	......
No. 1397. J. T. Doyle, Cupertino	Oct. 18	24.60	......	.31	......	......	......	......	......	......	......	......
No. 1423. J. Gallegos, Mission San José	Oct. 31	28.00	......	.34	......	......	......	......	......	......	......	......
1891—No. 1476. Fresno	Aug. 28	24.10	23.62	.36	.48	*16.31	20.00	.11	......	2.45	......	1.50
No. 1519. Mission San José	Sept. 30	25.45	......	.53	......	......	......	......	......	......	......	......
1892—No. 1654. Paso Robles	Sept. 13	21.30	20.21	.39	.31	*15.67	19.28	.38	......	2.55	......	1.40
No. 1671. Tulare	Sept. 17	23.70	22.67	.32	.48	*15.42	18.98	.37	......	2.55	......	1.25
No. 1780. Mission San José	Oct. 13	20.50	19.75	.55	......	8.00	10.25	.59	......	2.55	......	......
1893—No. 1843.‡ Tulare	Sept. 10	21.95	20.24	.38	.52	*14.75	18.88	.32	......	4.00	......	1.39
No. 1875.‡ Amador station	Sept. 12	20.60	......	.47	......	......	......	......	......	......	......	......
No. 1979. Tulare	Oct. 16	23.70	22.23	.26	.39	......	......	......	......	......	......	......
No. 2019. Mission San José	Oct. 26	22.90	21.38	.61	.35	*13.81	17.70	.48	......	4.30	......	1.83
No. 2067. J. T. Doyle, Cupertino	Oct. 31	24.80	......	.47	......	......	......	......	......	......	......	......
1894—No. 2154. Tulare	Sept. 15	24.00	......	.28	......	......	......	......	......	......	......	......
No. 2165. Amador station	Sept. 17	24.05	22.67	.44	......	......	......	......	......	......	......	......
No. 2166. Amador station	Sept. 17	24.40	23.13	.38	......	......	......	......	......	......	......	......
No. 2251. Mission San José	Oct. 3	22.40	......	.41	......	......	......	......	......	......	......	......
No. 2292. Tulare	Oct. 10	24.60	24.01	.28	......	......	......	......	......	......	......	......

* Fortified. † Wine sent for examination. ‡ "Golden Chasselas."

RECORD OF TREATMENT.

No. 683. *Palomino*, from R. Wegener, Livermore. The grapes arrived September 16, 1887, and were worked the following day. Their condition was good, so far as transportation was concerned, but many of the berries were half-dried and some rotten and fermenting. They were picked over before crushing. The bunches were very characteristic, large, loose, with many pendent branches; there was very little coulure; the berries were, on the average, small, but very unequal, strictly globular, bronzed on the exposed side, thick-skinned, sweet, and low in acid. The must showed 22.6% of solid contents by spindle and 0.38% of acid. The must from 80 lbs. was crushed, and reached a maximum temperature of 81° on the third day. The grapes yielded juice at the rate of 150 gals. per ton.

Ten days after crushing the wine was drawn off from the thick lees, and at three months was bright, with some aroma, sound and agreeable. It was racked for the second time at four months; and at eight months, the lees showing some unsound germs, it was racked again and pasteurized. Six weeks later it was clear and had developed some bouquet; the acid was moderate, but slightly sharp. At sixteen months the wine was distilled for brandy.

No. 698. *Palomino*, from Cupertino. The grapes were received October 6, 1887, and crushed the following day. They were in good condition; the bunches large and compact, the berries generally large, but some small and deeply colored; there was little coulure. The must showed 19.57% of solid contents by spindle and 0.37% of acid. The maximum temperature reached during fermentation was 85°, on the third day. The 113 lbs. of grapes crushed yielded must at the rate of 158 gals. per ton.

In three weeks the wine was drawn off from the thick lees. At two months it was clear, of good aroma, medium and agreeable acid, sound, and well advanced. At seven months the wine was racked and pasteurized for safety. At seven months it was a neutral wine of moderate acid and rather backward development. At fifteen months it was distilled for brandy.

No. 727. *Palomino*, from Mission San José. The grapes were received October 13, 1887, and worked the following day. They were in fair condition, but of very uneven degrees of development, being from vines of various ages. The berries were, on the average, 40% larger than those of No. 683, Palomino, from Livermore. Some of the berries were dried to raisins and some were sunburned. The must showed 22.0% of solid contents by spindle and 0.35% of acid. The fermentation reached its maximum on the third day at a temperature of 86°, and was finished on the thirteenth day. The yield from 98.8 lbs. crushed was at the rate of 120 gals. per ton.

Three weeks after crushing the wine was drawn off from the thick lees. Three weeks later it was still turbid, but showed good quality; the acid, however, was rather suspicious. An examination of the lees showed the presence of improper germs, so the wine was racked off and pasteurized. At eight months it was clear, much improved, a light wine with some bouquet. It was racked again, and at fifteen months was distilled for brandy.

No. 728. *Palomino*, from Cupertino. The grapes were received October 14, 1887, and crushed the same day. The lot was in excellent condition, and mature. The bunches were very large and fine, and showed very little coulure; one bunch weighed nearly 2 lbs. The berries were very large, and of good flavor. The must showed 23.3% of solid contents by spindle and 0.47% of acid. The 102.3 lbs. crushed yielded at the rate of 137 gals. per ton. The temperature of the grapes at crushing was 69.5°, and the maximum reached was 82°, on the third day.

Two weeks after crushing the wine was drawn off from the thick lees. At two months the wine was still cloudy, with good acid and some aroma. The lees showed some unsound ferments, so the wine was racked and pasteurized. At eight months the wine was clear, had developed some bouquet, but was not quite clean-tasting, and had less Sherry taste than No. 765. At this date it was racked again, and at fifteen months it was distilled for brandy.

No. 765. *Palomino*, from Cupertino. Received October 21, 1887, in fair condition. The bunches were large, but much coulured; the berries uneven in size, and on some bunches abortive and dried up before maturity. The must showed 23.09% of solid contents by spindle and 0.42% of acid. The 93 lbs. crushed yielded juice at the rate of 120.9 gals. per ton. The temperature of the grapes at crushing was 74°, and the maximum reached was 83°, on the second day.

At two months the wine was still a little cloudy; it had but little aroma, and had a suspicious taste. A microscopic examination of the lees showed unsound germs, so the wine was racked and pasteurized. At eight months it had improved very much, had developed some bouquet and a full Sherry taste, but was not quite clean-tasting. It was racked again, and at fifteen months distilled for alcohol.

No. 952. *Palomino*, from Cupertino. Received November 7, 1888, in excellent condition, and mature. The bunches were loose and the berries of good size. The must showed 21.57% of solid contents by spindle and 0.18% of acid. The 105 lbs., which were crushed on the day they arrived, yielded 7 gals. of wine, being at the rate of 133 gals. per ton. The temperature of the grapes at crushing was 70°, and the maximum reached was 84°, on the third day. The wine was dry on the twelfth day.

At three weeks the wine was racked and taken to the cellar. At three months it was not quite clear, but was sound and good, and had some flavor and bouquet. At five months the lees were sound, but at six months they showed some unsound germs, so the wine was pasteurized. Two months after pasteurizing it was racked; it was clear and tasted sound. At nine months it was bright, with marked and agreeable flavor, full acid, clean taste, and advanced development. At fourteen months the wine in the keg was in good condition. Some bottled at four months was sound, but tasted flat; some bottled at eight months was very good, but had less bouquet than that in the keg. At fifteen months the wine was mature, and was bottled; it was in good condition, and showed less character and more acid than No. 951, the imported Palomino. At two years and four months the bottled wines were tasted. That bottled at four months was spoiled. There was little difference between that bottled at eight months and that bottled at fifteen—both were bright, of agreeable, neutral flavor, little bouquet, and low body. After this the earlier bottled wines deteriorated. That bottled later improved for about a year, acquiring a "goût de rance," but after that deteriorated, and at seven years had contracted a "mousy" taste.

No. 1041. *Palomino*, from Fresno. Received September 5, 1889, in fair condition. The bunches were of medium size, very ripe, but not dried. They were crushed on the day they arrived, and yielded at the rate of 146 gals. per ton. The temperature of the grapes at crushing was 70°, and the maximum reached was 84°, on the fourth day. On the sixth day the wine had fermented sufficiently, and was fortified.

At four months the wine was clear and of agreeable aroma and flavor, with rather too much acid, but giving promise of good quality. It was racked, and, being too dry, was sweetened by the addition of a small quantity of rock-candy. A month later it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At nine months it was racked for the third time; it was bright, of good amber color, and good quality. At thirteen months it was in good condition, and showed much improvement in bouquet and flavor. At twenty-two months it was clear, full-flavored, and well developed. At six years it was in good order, and mature. It was a very smooth, clean-tasting, sweet Sherry, full-flavored, and with some bouquet.

No. 1171. *Palomino*, from Mission San José. Received October 16, 1889, in good condition, and mature. The grapes were crushed the same day, and yielded at the rate of 144 gals. per ton. The temperature of the grapes at crushing was 63.5°, and the maximum reached was 81°, on the third day. On the second day, when the temperature had risen to 77°, 0.25 gal. of spirits at 73% was added to the 3.6 gals. of must. On the third day 0.125 gal. was added, and on the seventh day the final addition of spirits was made.

At four months the wine was clear, clean-tasting, and agreeable, but without much character. A week later it was put in the heating-chamber, at a temperature of from 90° to 95°. At eight months it was racked for the second time; it was bright and showed much general improvement. Four months later it was in good condition and was getting on well. At twenty-one months it was bright and good, but slightly bitter. At two years and five months it had developed into a fair Sherry, but was still rather raw. Four years later it was in good condition, smooth and clean-tasting, with good Sherry flavor and more character than No. 1191, Pedro Jimenes, from Cupertino.

No. 1198. *Palomino*, from Cupertino. The grapes were received October 24, 1889, in fair condition, and mature. They were crushed the same day, and yielded at the rate of 160 gals. per ton. The must showed 23.7% of solid contents by spindle and 0.22% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 76.5°, on the third day.

The wine was racked at two weeks, and at six weeks was bright, of agreeable flavor and aroma; it was racked and taken to the cellar, but after this it deteriorated, and at three months the odor was not good, the lees showed secondary ferments, and the wine had to be pasteurized. At ten months it had improved, was smooth and agreeable, but not quite clear, and was of inferior aroma. After this it deteriorated, and at sixteen months, though it was bright, it had suffered from the smallness of the keg and had to be put in glass. It changed little in glass for some time, but was evidently of such poor keeping quality that it was thrown away.

No. 1239. *Palomino* (Golden Chasselas), from Margherita Vineyard, Fresno. Received August 26, 1890, in good condition, and mature. The must showed 23.9% of solid contents by spindle. The fermentation continued for three days, at the end of which time the murk was fortified while still sweet. The maximum temperature reached was 82°.

At three months after crushing the wine was bright, possessed of a good aroma, full flavor, low acid, and too much sugar. At five months it was still in good order, but was too low in alcohol, and was therefore refortified. At seven months it was racked for the second time, and placed in the heating-chamber, at a temperature of 105°, where it was kept for three months. At seventeen months the wine was in first-class condition, had a good flavor, but had lost some of its aroma.

No. 1311. *Palomino* (Golden Chasselas), from J. T. Doyle, Cupertino. Received October 10, 1890, in fair condition; very fine grapes, but most of the bunches had a few rotten berries. The must showed 20.85% of solid contents by spindle. The fermentation was cool and somewhat prolonged, lasting over eight days.

At one month the wine was nearly clear, possessed of a marked aroma, agreeable flavor, and full, pleasing acid. At two months it was racked for the second time, and a month later, the lees showing some lactic germs and the taste beginning to be affected, it was pasteurized. At seven months it was clear and had improved, but still had a faint suspicion of lactic taint in the odor. At fourteen months the lactic ferment had quite disappeared, and the wine had some bouquet and full flavor; it was mature, or nearly so. Two months later the wine was in good condition, having been racked four times, and was bottled. At two years the bottled wine was clear, somewhat deficient in bouquet and freshness, but of good flavor and body.

No. 1397. *Palomino*, from J. T. Doyle, Cupertino. A sample for must analysis arrived October 21, 1890, in fair condition, and mature. The must showed 24.6% of solid contents by spindle.

No. 1423. *Palomino*, from Mission San José. A sample for must analysis arrived October 31, 1890, in fair condition; perfectly mature, and a few of the grapes dried up. The must showed 28.0% of solid contents by spindle.

No. 1476. *Palomino*, from Margherita Vineyard, Fresno. Received August 31, 1891, in good condition. The must showed 24.1% of solid contents by spindle and 0.36% of acid. The grapes were crushed the day of arrival, and the must divided into two lots, which were fermented separately.

No. 1476. The temperature of the must at crushing was 65°, and the maximum reached was 75°, on the third day. On the sixth day the wine was fortified. At four months it was bright, full-flavored, clean-tasting, and with very little sweetness. At five months it was racked for the second time, and a month later put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months it was in good condition, with full flavor and aroma, but slightly bitter. Four months later it showed the effect of being in so small a keg; the sweetness had increased very much by condensation, so the wine was put in glass. At four years and five months it was a full-flavored, agreeable Sherry, but tasted of the keg.

No. 1476*a*. The temperature of the grapes at crushing was 65°. The must was fortified to 5% of alcohol before the fermentation commenced. The maximum temperature reached was 73.5°, on the fourth day. On the eleventh day the wine was still fermenting a little, and as sufficient sugar had been eliminated, the spirits necessary to complete fortifying were added. At four months the wine was bright, full-flavored, and clean-tasting, with moderate sweetness; differed little from No. 1476. A month later it was racked, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At fourteen months it was in good order, full-flavored, a rather good Sherry, with the peculiar Palomino flavor. The sweetness had increased considerably by evaporation. At this age it was put in glass and loosely stoppered. At four years and five months it differed little from No. 1476, and was still somewhat raw and immature.

No. 1519. *Palomino*, from Mission San José. A sample for must analysis was received October 1, 1891, in good condition, but not mature. The must showed 25.45% of solid contents by spindle and 0.53% of acid.

No. 1654. *Palomino*, from Paso Robles station. Received September 16, 1892, in good condition. The grapes and bunches were very small for the variety. The must showed 21.3% of solid contents by spindle and 0.39% of acid. The temperature of the grapes at crushing was 68°, and the maximum reached was 75°, on the third day. On the fourth day the wine was fortified.

At three weeks the wine was clear, and was racked. At three months it was bright, clean-tasting, nearly dry, and with low acid. At six months it was refortified, sweetened by the addition of a little rock-candy, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was bright; it had the distinctive Palomino flavor, but had not yet developed much "rancio." Seventeen months later it had improved, but was lacking in delicacy. At three years and five months it was in good condition; the "rancio" taste was well developed, and the wine was a full-flavored Sherry of good quality.

No. 1671. *Palomino*, from Tulare station. Received September 19, 1892, in very good condition, and mature. The must showed 23.7% of solid contents by spindle and 0.32% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 82°, on the third day. The wine was fortified on the sixth day.

In three weeks the wine was clear, and was racked. At three months it was bright and of good flavor, but too dry. At six months it was sweetened by the addition of a little rock-candy, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was bright, but still very raw. At two years it was in good order, with full aroma and strong, characteristic flavor. Diluted with one third Beba to soften it and dilute its somewhat too prominent flavor, it made a good Sherry. At three years and five months it was in good order, more highly flavored than No. 1670, Pedro Jimenes, but less delicate and less mature.

No. 1780. *Palomino*, from Mission San José. Received October 15, 1892, in fair condition, but not mature. The must showed 20.5% of solid contents by spindle and 0.55% of acid. The temperature of the grapes at crushing was 58°, and the maximum reached was 81°, on the third day. On the seventh day the wine was dry and was drawn off from the thick lees.

In three weeks the wine was clear, and at one month it was racked for the second time. At three months it was bright, of rather good aroma and flavor, medium acid and body. Two months later it was in first-class condition and very agreeable. At five months it was racked for the third time, and remained perfectly bright until it was bottled. Tastings at eight, ten, and fourteen months showed gradual improvement and quick maturing; the wine tasted rather green, but had full, characteristic flavor, and kept well. At fifteen months it was mature, and was bottled. Two years after bottling the wine was bright and had made no deposit in the bottles; it was neutral, lacking in bouquet, but smooth and agreeable.

No. 1843. *Palomino*, from Tulare station. Received September 12, 1893, in good condition. The bunches were rather small and straggling. The must showed 21.95% of solid contents by spindle and 0.38% of acid. The temperature of the grapes at crushing was 65°, and the maximum reached was 81°, on the second day. The wine was fortified on the second day, when it had about 4% of solid contents.

At three months the wine was bright and of moderate sweetness. It was racked for the second time, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was racked again. At two years and five months it was bright, full flavored, but still raw and undeveloped.

No. 1875. *Palomino*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches varied very much in size; the berries were large, well-flavored, and nearly mature. The must showed 20.6% of solid contents by spindle and 0.47% of acid.

No. 1979. *Palomino*, from Tulare station. Received October 18, 1893, in good condition. The bunches were of medium size, loose and irregular; the berries large, round, or flattened vertically, sweet, and with very little acid. The must showed 23.7% of solid contents by spindle and 0.39% of acid. The temperature of the must at crushing was 61°, and the maximum reached was 78°, on the third day. The wine was fortified on the fifth day. At two months the wine was bright and had about the right amount of sweetness; it was racked for the second time, and at five months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At nine months it was racked for the third time. At fourteen months it was in good order, smooth, and agreeable, with low acid and good flavor; in general, very promising.

No. 2019. *Palomino*, from Mission San José. Received October 26, 1893, in good condition. The bunches were large, conical, loose, but well filled; the berries of medium size, round, firm, and crisp, but not hard like the same variety from Tulare; the grapes were ripe and of agreeable flavor. The must showed 22.9% of solid contents by spindle and 0.61% of acid. The temperature of the grapes at crushing was 62°, and the maximum reached was 78°, on the third day. The wine was fortified on the sixth day.

At six weeks the wine was bright and a little too sweet. It was racked for the second time, and at two months was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was racked for the third time, and at fourteen months it was bright and in good order, smooth and agreeable, with rather too much acid and not so much flavor as the Tulare sample. At two years and four months it showed some improvement; it was a good, clean-tasting wine, and had developed some Sherry character.

No. 2067. *Palomino*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition, and mature. The bunches were large, irregularly short, conical, and well filled; the berries over medium in size and well flavored. The must showed 24.8% of solid contents by spindle and 0.47% of acid.

BEBA.

(See Vit. Rept. 1883–85, p. 135.)

This variety is cultivated over a wide area in southwestern Spain, but nowhere in large quantities. It is used to some extent mixed with other grapes in the production of wines, but is esteemed principally as a table-grape and for keeping through the winter. In parts of the province of Cadiz it is used for the production of raisins. The grapes are dipped in lye before being dried.

Description.—The vine is of medium size, and buds early; the leaves are over average in size, five-lobed, with shallow sinuses, the lower often wanting, upper surface glabrous, the lower with a little close wool; bunches large, irregular, often branching, well-filled; berries medium to large, round, hard, and fleshy, without distinct flavor.

The Beba resembles very much the Palomino in the character of its grapes, which ripen about the same time and have the same tendency to be low in acid. It has shown, on the average, more sugar than the Palomino, but this may be accounted for by the fact that it has generally borne less. As to the quality of the wine, it is of very much the same character as that of the Palomino, but is rather more neutral and quite unfitted for the manufacture of dry wines.

ANALYSES OF MUSTS AND WINES.

BEBA.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body	Ash	Sugar
							By Weight	By Volume				
1884—No. 271.	Natoma	Oct. 7	22.60	....	.25	....	11.62	14.27	.50	2.10	.37	....
1892—No. 1676.	Tulare	Sept. 19	23.70	....	.26	....	*15.58	*19.18	.38	2.92	....	1.18
1893—No. 1816.	Tulare	Sept. 2	21.05	20.61	.38	.67	....	*17.20	.41	2.90	....	....
No. 1854.	Amador station	Sept. 12	22.60	....	.49	....	....	....	....	....	....	....
No. 1965.	Paso Robles	Oct. 16	27.21	....	.29	....	....	....	....	....	....	....
1894—No. 2163.	Amador station	Sept. 17	25.20	....	.38	....	....	....	....	....	....	....
No. 2169.	Tulare	Sept. 18	24.80	24.12	.26	....	....	....	....	....	....	....

* Fortified.

Record of Treatment.

No. 1676. *Beba*, from Tulare station. Received September 21, 1892, in good condition. The must showed 23.7% of solid contents by spindle and 0.26% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 82°, on the second day. On the fourth day the wine was fortified.

In two weeks the wine was clear, and was racked. At three months it was bright, of good flavor, but a little too dry. At six months it was racked for the third time, and was sweetened by the addition of a little rock-candy. At thirteen months it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and three months it was in good order, with full, rich flavor and good body and aroma—a very good Sherry, equal to the Pedro Jimenes, but with rather less aroma; a little too sweet. Fourteen months later it had changed very little; it was a good Sherry, but not quite mature and a little bitter.

No. 1816. *Beba*, from Tulare station. Received September 4, 1893, in good condition. The bunches were large, irregular, fairly compact, but not compressed; the berries were round, over medium in size, with little flavor, but mature. The must showed 21.05% of solid contents by spindle and 0.38% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 83°, on the third day. On the fourth day the wine was fortified while still sweet.

At three months the wine was bright and not quite sweet enough. It was racked for the second time, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was racked for the third time. At sixteen months it was bright, of good aroma, smooth and agreeable, but still raw. At two years and four months it was bright, with good, marked aroma and full flavor, but little "rancio," still undeveloped, but promising.

No. 1854. *Beba*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition, and mature. The bunches were rather small and straggling; the berries of all sizes. The must showed 22.6% of solid contents by spindle and 0.49% of acid.

No. 1965. *Beba*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in good condition, but not quite mature. The bunches were of medium size, very branching, and irregular; the berries round, small, and hard. The must showed 27.2% of solid contents by spindle and 0.29% of acid.

PERRUNO.

There are several varieties of Perruno in southwestern Spain, one of which, the Perruno Comun, is planted in large quantities, and is considered the best wine-grape of the region, next to the Pedro Jimenes and the Palomino. The variety which is growing at the Experiment Stations seems, however, to be the Perruno duro, a variety which is much less extensively planted, but which is also held in high esteem for wine, and is, besides, much appreciated as a table-grape on account of the lateness of its period of ripening and the resistance of its grapes to the weather and decay.

Description.—Leaves of medium size, five-lobed, the upper lobes overlapping, glabrous above, with a little wool below, teeth very obtuse; bunches large and well filled; berries very large, round, hard, and with little flavor.

The Perruno has shown itself a vigorous grower and good bearer in the sandy, alkali soil of the Tulare station. Its must composition shows it to be preëminently a grape for sweet wines, but, like the Mantuo, its character is too neutral and requires the addition of some grape of higher quality. Though said to ripen very late in Spain, its period of ripening in California is considerably earlier than that of the Mantuo; it has also generally attained a higher sugar content than the latter, so that, on the whole, it is to be preferred to that variety.

ANALYSES OF MUSTS AND WINES.

PERRUNO.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric at Six to Eight Months	Body	Sugar
1884—No. 268. Natoma	Oct. 8	22.76	------	.31	.31	9.92	12.35	.52	1.95	------
1892—No. 1687. Tulare	Sept. 27	22.60	22.23	.29	.40	*16.23	*19.96	.28	2.48	1.62
1893—No. 1874. Amador station	Sept. 12	18.40	------	.51	----	------	------	------	------	------
No. 1905. Tulare	Oct. 1	22.20	20.61	.41	.34	------	*19.00	.48	2.88	.72
No. 1958. Paso Robles	Oct. 13	26.30	------	.15	---	------	------	------	------	------
1894—No. 2184. Amador station	Sept. 22	24.10	------	.39	----	------	------	------	------	------
No. 2289. Tulare	Oct. 6	22.85	22.04	.35	----	------	------	------	------	------

*Fortified.

RECORD OF TREATMENT.

No. 1687. *Perruno*, from Tulare station. Received September 29, 1892, in good condition. The must showed 22.6% of solid contents by spindle and 0.29% of acid. The temperature of the grapes at crushing was 72°, and the maximum reached was 80°, on the second day. On the fourth day the wine was fortified.

At three months, when it was racked for the first time, it was bright, but still very raw. At six months it was racked again, sweetened, and refortified. At twelve months it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years it was in good order, with sufficient sugar and alcohol and full body; a fairly good Sherry, but coarse and not equal to Pedro Jimenes. It was much improved by the addition of one half No. 1705*a* (Napoleon). Fourteen months later it had much improved, was well aged, possessed of a good aroma and flavor, but was a little bitter.

No. 1874. *Perruno*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches and berries were very large, but not quite mature and with little flavor. The must showed 18.4% of solid contents by spindle and 0.51% of acid.

No. 1905. *Perruno*, from Tulare station. Received October 2, 1893, in good condition. The bunches were very large and well filled; the berries very large, round, and hard, not quite mature, and very insipid. The must showed 22.2% of solid contents by spindle and 0.41% of acid. The temperature of the must at crushing was 70°, and the maximum reached was 82°, on the third day. On the fifth day the wine was fortified.

At two months the wine was clear and had very little sweetness. At this date it was racked, and again at six months, when it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At nine months it was racked again, and at fourteen months it was in good condition—a smooth wine of good character, but very undeveloped and tasting of the cask. At two years and four months it had improved and was a good Sherry but for the taste and smell of the cask, which still persisted.

No. 1958. *Perruno*, from Paso Robles station. A sample for must analysis was received October 15, 1893, in good condition. The bunches were large, irregular, and loose; the berries of medium size, round, very hard, and fleshy. The must showed 26.3% of solid contents by spindle and 0.15% of acid.

MANTUO DE PILAS.

(See Vit. Rept. 1883-85, p. 133; 1885-86, p. 106.)

Synonyms: Monte Olivette; Uva de Rey; Gabriela.

This variety is much esteemed for wine-making in southwestern Spain, where it is planted in considerable quantities for blending with the Palomino, to which it is believed to add aroma. In some localities it is cultivated as a raisin-grape, and in others it is much esteemed as a table-grape. It is very useful for winter keeping, and in some vineyards is left on the vines till after the first autumn rains, to be shipped as a late eating-grape to the Madrid markets.

Description.—Vine productive; canes whitish and very hard; leaves large, with five distinct lobes, more or less overlapping when young, the sinuses much shallower when old, upper surface glabrous even when young, the lower white with close wool, teeth large; bunches large, pyramidal, winged, loose; berries very large, nearly round, crisp, fleshy, hard, and of neutral flavor.

This variety, next to the Pedro Jimenes, is the finest looking and largest of all white Spanish grapes growing at the Experiment Stations. It is rather later than the others, and requires a hotter climate, but at Tulare its fine bunches of large berries should make it very useful as a late table-grape. Its grapes show the same tendency to low acid as the other Sherry grapes in even a more marked degree. It makes a good sweet Sherry, but not quite equal in quality to either the Palomino or the Beba; it is quite neutral in character, and requires blending with a grape of more marked flavor.

ANALYSES OF MUSTS AND WINES.

MANTUO DE PILAS.	Date of Picking.	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body	Ash	Sugar
1884—No. 269. Natoma	Oct. 8	18.63	......	.35	......	7.85	9.82	.53	1.32	.27	......
1885—No. 477. Natoma	Sept. 19	20.40	20.02	.37	.42	7.78	9.73	.45	......	......	......
No. 497. Natoma	Sept. 24	20.40	......	.28	......	8.48	10.58	.35	......	......	......
1892—No. 1688. Tulare	Sept. 27	23.50	23.42	.37	.58	*14.64	*18.03	.31	2.53	......	1.77
1893—No. 1877. Amador station	Sept. 12	19.30	......	.50	......	......	......	......	......	......	......
No. 1957. Paso Robles	Oct. 14	22.75	......	.30	......	......	......	......	......	......	......
No. 1966. Tulare	Oct. 12	21.50	20.17	.38	.48	......	*17.50	.35	3.30	......	......
1894—No. 2182. Amador station	Sept. 22	22.10	......	.40	......	......	......	......	......	......	......
No. 2332. Tulare	Oct. 13	23.30	22.23	.32	......	......	......	......	......	......	......

*Fortified.

RECORD OF TREATMENT.

No. 1688. ***Mantuo de Pilas***, from Tulare station. Received September 29, 1892, in good condition. The must showed 23.5% of solid contents by spindle and 0.37% of acid. The temperature of the grapes at crushing was 71°, and the maximum reached was 79°, on the second day. The wine was fortified on the fourth day.

In six weeks the wine was clear, and was racked. At two months it was bright, of good flavor, but too dry. At three months it was racked for the second time, and at six months it was sweetened with rock-candy, and refortified. At one year it was put in the heating-chamber, at a temperature of from 90° to 95°. At two years and two months it was in good order—a good, light Sherry, more delicate than No. 1687 (Perruno), but with less character than the Pedro Jimenes. Fourteen months later it had improved, but was still raw.

No. 1877. ***Mantuo de Pilas***, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. Both bunches and berries were very large, and closely resembled Mourisco branco. The must showed 19.3% of solid contents by spindle and 0.50% of acid.

No. 1957. ***Mantuo de Pilas***, from Paso Robles station. A sample for must analysis was received October 15, 1893, in fair condition. The bunches were large, pyramidal, winged, loose; the berries of medium size, round, crisp but not hard, not very sweet, and with little flavor. The must showed 22.75% of solid contents by spindle and 0.30% of acid.

No. 1966. ***Mantuo de Pilas***, from Tulare station. Received October 14, 1893, in very good condition. The bunches were large, irregular, loose; the berries very large, slightly oval, crisp, and with very little acid. The must showed 21.5% of solid contents by spindle and 0.38% of acid. The temperature of the grapes at crushing was 62°, and the maximum reached was 78°, on the second day. On the fifth day the wine was fortified.

At two months the wine was bright, but too dry. It was racked first at two months and then at five months, when it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At nine months it was racked again, and at fourteen months it was in good order, neutral, with little aroma or flavor, and still very raw.

MOURISCO BRANCO.

(See Vit. Rept. 1883–85, p. 134; 1885–86, p. 107.)

The Mourisco branco is a large, white grape of the Douro region of Portugal. It is very common and, unlike its black congener, the Mourisco preto, is used principally for the table. For this purpose it is very much esteemed.

Description.—Canes chestnut-colored; leaves rather large, round in outline, with shallow sinuses, upper lobes overlapping, upper surface quite glabrous, lower with a little close, white wool, which disappears with age; bunches large, irregular, winged, loose; berries large to very large, round, flattened at the ends, crisp, on slender pedicels.

This variety has a close family resemblance to the large, white Sherry grapes of southwestern Spain, but is not identical with any of the varieties which are planted at the Experiment Stations, so far as is yet made out. In must composition, general appearance of grapes, and time of ripening, it has a strong resemblance to the Mantuo de Pilas, but the berries are less hard and there is a considerable difference in the leaves. It has not yet been tested sufficiently for an opinion to be ventured as to its suitability to California, but the indications are that it will be useful as a sweet-wine grape in localities similar to those which are suitable to the grapes of Jerez.

ANALYSES OF MUSTS AND WINES.

MOURISCO BRANCO.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Body	Ash
						By Weight	By Volume			
1884—No. 270. Natoma	Oct. 7	22.60	......	.25	....	*11.62	*14.27	.50	2.10	.37
1885—No. 482. Natoma	Sept. 20	25.10	24.97	.31	.40	10.07	12.54	.33	....	...
1892—No. 1716. Tulare	Oct. 3	23.40	......	.33	....	......	......	......	....	...
1893—No. 1876. Amador station	Sept. 14	18.20	......	.60	....	......	......	......	....	...
No. 1970. Tulare	Oct. 14	23.50	21.80	.32	.34	*14.97	*19.08	.30	3.10	...
1894—No. 2183. Amador station	Sept. 22	20.00	......	.49	....	......	......	......	....	...
No. 2312. Tulare	Oct. 11	22.60	......	.30	....	......	......	......	....	...

* Fortified.

RECORD OF TREATMENT.

No. 1716. *Mourisco branco*, from Tulare station. A sample for must analysis was received October 5, 1892, in good condition. The must showed 23.4% of solid contents by spindle and 0.33% of acid.

No. 1876. *Mourisco branco*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches and berries were very large, without much flavor, and immature. The must showed 18.2% of solid contents by spindle and 0.60% of acid.

No. 1970. *Mourisco branco*, from Tulare station. Received October 16, 1893, in good condition. The bunches were large, irregular, winged, loose; the berries very large, round, flattened at the ends, crisp, on slender pedicels. The must showed 23.5% of solid contents by spindle and 0.32% of acid. The temperature of the grapes at crushing was 63°, and the maximum reached was 74°, on the third day. On the fifth day the wine was fortified.

At two months the wine was bright, of good bouquet and flavor and slight sweetness. It was racked, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was racked again. At three years and four months it was in good condition, showed marked aroma and flavor, clean taste, moderate sweetness, little "rancio," still raw and undeveloped.

VERDELHO.

(See Vit. Rept. 1883-85, p. 135; 1885-86, p. 106.)

Synonym: Verdelbo di Madeira.

This grape is cultivated extensively in the Island of Madeira, where it enters into the finest grades of wines, especially of dry wines. It is almost or quite equal in quality to the Sercial, the principal dry-wine grape of Madeira, and superior in productiveness and robustness. It is cultivated to some extent in France, but more for the table than for wine. It has been introduced successfully into the Crimea, and was among the first varieties to give satisfactory results in Australia.

Description.—The vine is vigorous, and productive in bunches, which are, however, of very light weight; it bears well with short-pruning; the canes are slender, short-jointed, with a light reddish tint; leaves small to medium, wider than long, the petiolar sinus open, the others small or absent, glabrous on both surfaces except for a little down on the main nerves, teeth distinctly mucronate; the bunches are small, winged or branched, and loose; the berries small, regular, ellipsoidal, on long, slender pedicels, of a transparent green color, becoming yellowish at maturity; flesh firm, sweet, and agreeably flavored.

The Verdelho ripens early, even in the coast counties, a week or two after the Chasselas; it is somewhat subject to coulure and mildew, but resists the weather well. The grapes are not injured by rain, on account of the looseness of the bunches, and they shrivel up gradually with overripeness. They attain regularly a high degree of sugar, and maintain a much larger percentage of acid than the Spanish Sherry grapes. The average composition of the must has been: at Cupertino and Mission San José, 26.9% of solid contents by spindle and 0.54% of acid; at Fresno and Tulare, 26.4% and 0.55%; at Paso Robles, 25.1% and 0.60%; at Amador station, 26.7% and 0.54%. Such similarity in results from such dissimilar localities shows a wide adaptability for this grape, and also indicates its value for the production of dry Sherries. It acquires a marked and delicate "rancio" flavor very quickly and easily, and its full aroma and high quality make it very valuable as an addition in the making of sweet wines. Its acid is too high to give the best results as a sweet wine when used alone, but the addition of one third to the neutral Sherry grapes with low acid, such as the Perruno, Mantuo, or Pedro Jimenes, is of great advantage to the latter.

TABLE OF PRODUCTION.

VERDELHO.	Number of Vines........	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking ....
1887—No. 766. J. T. Doyle, Cupertino..................	20	28	1.4	Oct. 20
1888—No. 867. J. T. Doyle, Cupertino..................	19	62	3.2	Sept. 27
1889—No. 1100. J. T. Doyle, Cupertino..................	19	75	3.9	Sept. 26
1887-96. E. W. Hilgard, Mission San José, average.....	320	900	2.8	....

ANALYSES OF MUSTS AND WINES.

VERDELHO.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body	Ash	Sugar
1884—No. 272. Natoma Wine Co., Natoma		27.35	25.88	.50	.37	*12.39	15.20	.42	2.82	.33	
1886—No. 568. E. W. Hilgard, Mission San José		25.90		1.00							
1887—No. 766. J. T. Doyle, Cupertino	Oct. 20	30.04	31.48	.49	.45						
1888—No. 838. J. Gallegos, Mission San José	Sept. 9	26.42		.57							
No. 867. J. T. Doyle, Cupertino	Sept. 27	24.15	24.33	.46	.26	9.85	12.27	.64	2.70		
No. 914. E. W. Hilgard, Mission San José	Oct. 16	28.22		.34	.32	*12.39	15.20	.41	2.95		
1889—No. 1100. J. T. Doyle, Cupertino	Sept. 26	26.90	26.99	.54	.40	10.81	13.27	.44	2.86		
1890—No. 1203. Margherita Vineyard, Fresno	Aug. 11	24.10	24.64	.65	.52	*14.75	18.22	.55	2.96		4.60
No. 1297. J. Gallegos, Mission San José	Oct. 1	25.90		.71	.22	*13.77	16.98	.72	3.06		4.50
No. 1322. J. T. Doyle, Cupertino	Oct. 11	27.65		.55							
1891—No. 1451. Tulare	Aug. 26	26.30		.56							
No. 1466. Fresno	Aug. 28	29.10		.54		*16.85	20.71	.45	2.99		1.36
No. 1466*a*. Fresno	Aug. 28	29.10		.54		*15.92	19.59	.36	3.02		1.58
No. 1485. Paso Robles	Sept. 9	24.10		.55							
No. 1518. Mission San José	Oct. 18	26.05	26.99	.71		*16.08	19.78	.51	3.80		
1892—No. 1689. Tulare	Sept. 26	25.90	27.65	.49		*16.46	20.24	.36	2.95		1.20
1893—No. 1859. Amador station	Sept. 13	26.10		.63							
No. 1904. Tulare	Oct. 1	25.75	25.76	.58	.43		19.90	.53	3.10		
No. 2013. Mission San José	Oct. 29	28.40	27.70	.55	.30						
No. 2102. Cupertino	Nov. 4	27.70		.44							
1894—No. 2180. Amador station	Sept. 22	27.35		.45							
No. 2219. Paso Robles	Sept. 26	26.06		.66							
No. 2220. Tulare	Oct. 1	27.15	26.31	.49							
No. 2249. Mission San José	Oct. 3	24.60		.55							

*Fortified.

RECORD OF TREATMENT.

No. 766. *Verdelho*, from Cupertino. Received October 21, 1887, in good condition. The grapes showed a great deal of early coulure (quite 50%), and the stems were somewhat shriveled. The bunches were large in comparison with the figure in "Les Vignobles," with which otherwise they agreed perfectly. The grapes were very sweet, with little acid, and in proper condition for making into wine. The must showed 30.04% of solid contents by spindle and 0.49% of acid. On October 23d, 25.5 lbs. were crushed. The maximum temperature reached was 82°, on the second day. The wine remained at that temperature for thirty-six hours. The grapes yielded wine at the rate of 142 gals. per ton. The wine was put in glass and unfortunately lost by breakage.

No. 838. *Verdelho*, from Mission San José. A sample for must analysis was received September 12, 1888, in good condition. The must showed 26.42% of solid contents by spindle and 0.57% of acid.

No. 867. *Verdelho*, from Cupertino. The grapes were received September 28, 1888, in good condition, and worked the same day. They showed from 25% to 80% of coulure, and were not quite ripe enough for Verdelho. The must showed 24.15% of solid contents by spindle and 0.46% of acid. The 41 lbs. of grapes crushed yielded 3.4 gals. of wine, or at the rate of 164 gals. per ton. The must started fermenting at a temperature of 63°, and gradually rose to a maximum of 78°, on the fourth day; it continued fermenting for six days more, when it was drawn off at a temperature of 73°.

One month after pressing the wine, being quite quiet, was taken to the cellar. Two months later it had become slightly cloudy; it was, however, of good quality, with low acid, sufficient alcohol and body, and characteristic aroma. Two months later it was pasteurized, as the lees showed some unsound germs. At eight months it was racked for the third time. At ten months it was not quite bright, but of good flavor and bouquet—would be of excellent quality but for suspicion of bad acid. Four months later, when it was racked again, it was bright and considerably improved. At sixteen months it was bright, full-flavored, and mature. The wine had been put in glass at fourteen months, but had deposited no sediment. At one year later it was clear, but had made a slight deposit. It was of good quality, with Sherry-like bouquet, but slightly bitter and lacking in freshness. Eighteen months later it had changed very little. At seven years from the time of making it was a fairly drinkable wine, showing good quality, of Sherry character, but still showed the effect of the slight unsound fermentation which it underwent before it was pasteurized.

No. 914. *Verdelho*, from Mission San José. The grapes were received October 18, 1888, and worked the same day. They were overripe, somewhat shriveled and soft, a few dried up to raisins, and a very few moldy. Considering that the grapes were from two-year-old grafts, and had been long exposed to foggy and changeable weather since ripening, they were in excellent condition. The must showed 28.22% of solid contents by spindle and 0.34% of acid. From 91 lbs. of grapes crushed, 7.2 gals. of wine were obtained, or at the rate of 156.6 gals. per ton. The temperature of the must at starting was 67°, and the maximum reached was 82°, on the fifth day. The wine was drawn off on the seventh day after a good fermentation.

Five weeks later the wine was racked and taken to the cellar. At three months it was still slightly cloudy, but of decided and agreeable Sherry aroma, full alcohol, and pleasing acid. Two months later it was in good condition and the lees were sound. At ten months it was clear, of good quality, a very pleasing dry Sherry. At fourteen months the wine in the keg was very good, but had a slightly bitter after-taste. Some of the wine which had been put in bottle at five months was sound, but undeveloped. At sixteen months the lees showed bitter ferments under the microscope. The wine was not quite bright, but was good except for the slight bitterness. The wine in bottle had not acquired the bitter taste. Five months later the wine had improved and was nearly mature. At twenty-two months it was bottled. At two years and four months the wine bottled at fifteen months was bright, of good flavor and bouquet, and with little deposit. That bottled at twenty-one months was similar, but rather darker in color. At four years both wines were of good quality, but that bottled first was cleaner-tasting and of richer flavor. At seven years the wine was clean-tasting, full-flavored, with a pronounced "rancio" taste, but lacking in bouquet.

No. 1100. *Verdelho*, from Cupertino. Received September 27, 1889, in fair condition, showing somewhat irregular ripening. The must showed 26.9% of solid contents by spindle and 0.54% of acid. From 70.5 lbs. crushed were obtained 5.1 gals. of wine, or at the rate of 143.6 gals. per ton. The must began fermenting at a temperature of 72°, and reached a maximum of 82° on the second day. The wine was dry on the eighth day, when it was drawn off.

At one month the wine was racked and taken to the cellar. It was clear, of full and agreeable aroma and low acid; it was a fruity wine, of high quality. At three months it had progressed well, was clear, solid, and of Sherry character. The lees were examined and found to be sound. Three months later it was in good condition, and was racked again. At this time the lees were sound, and two months later the wine was bright, with full, rich bouquet and flavor, and well advanced toward maturity. At fifteen months it was still bright, but began to show the effect of being in so small a keg, and in order to preserve it, it was pasteurized and put in bottle. A year later it was bright and had improved somewhat. At three years it showed good quality, but also the effect of being made in so small a quantity.

No. 1203. *Verdelho*, from Fresno. Received August 14, 1890, in excellent condition. The grapes were of unequal ripeness, and some of them tasted green. The bunches were of medium size and well filled; the berries small, both bunches and berries very uniform in size. The must showed 24.1% of solid contents by spindle and 0.65% of acid. The temperature of the must at crushing was 69°, and the maximum reached was 98°, on the third day. The fermentation was conducted in a room kept at an average temperature of 95°. On the seventh day the wine was evidently stuck with over 10% of solid contents. It was racked from the thick lees and left in the hot room. On the ninth day 3 pro mille of ammonium phosphate was added to it. This revived the fermentation a little, but the wine stuck again with 9% of solid contents.

At three weeks the wine had still 9% of solid contents, and showed large quantities of the mannite ferment under the microscope. The wine was racked and fortified. At three months it was clear, but of unpleasing odor. Two months later it was racked again and refortified. At nine months it was placed in the heating-chamber, at a temperature of 100°, for three months. At eighteen months it was bright and improved; it had some bouquet and flavor, but was too acid and did not promise to be anything fine; it was racked for the fourth time. Two years later it had improved very much, was smooth, clean-tasting, and of good Sherry flavor. At twenty-seven months it was a good wine and fairly well matured, its chief fault being too high acidity. It was put in glass, and fifteen months later was bright, of good aroma and full flavor. It was a sweet wine of good quality, its only serious fault being too much acidity.

No. 1297. *Verdelho*, from Mission San José. Received October 3, 1890, in good condition, and completely mature. The grapes were smaller than usual. The must showed 25.9% of solid contents by spindle and 0.71% of acid. The temperature of the must at crushing was 67°, and the maximum reached was 81°, on the third day. It was fortified on the fourth day.

At one month the wine was nearly clear, but showed poor quality, lacked aroma, and was too high in acid. Two months later it was bright, had improved a little, but was very flavorless. At this time it had 16% of alcohol and 7.9% of solid contents. Two months later it was refortified. At seven months it was put in the heating-chamber, at a temperature of 105°, for three months. At fifteen months it had improved, was bright, and had acquired a rather pleasing but not marked bouquet. It was, however, too thin and too acid to ever make a good Sherry. At this date it was racked for the fifth time. Two years later it was in good condition, clean-tasting, improved in flavor and aroma, but still too acid and a little too sweet. When four years old it was put in glass, and corked loosely. At five years the wine was in good condition, but not nearly so good a wine as No. 1203, Verdelho, from Fresno. It lacked character and was slightly bitter.

No. 1322. *Verdelho*, from Cupertino. A sample for must analysis was received October 11, 1890, in fair condition, and quite mature, some of the berries being dried up. The must showed 27.65% of solid contents by spindle and 0.55% of acid.

No. 1451. *Verdelho*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 26.3% of solid contents by spindle and 0.56% of acid.

No. 1466. *Verdelho*, from Fresno. Received August 31, 1891, in good condition. The must showed 29.1% of solid contents by spindle and 0.54% of acid. The grapes were divided into two lots, No. 1466 and No. 1466*a*, which were fermented separately.

No. 1466. The temperature of the must at starting was 66°, and the maximum reached was 76°, on the fourth day. On the seventh day, when the wine was still a little sweet, it was fortified. When the wine was four months old it was bright, straw-colored, full-flavored, and with medium sweetness. A month later it was racked for the second time, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and a half it was in good condition, with full aroma, good Sherry taste, clean and smooth—a very good wine. At three years and two months it was in excellent order and had matured well. It was put in glass, and at four years and five months was a good, full-flavored Sherry.

No. 1466*a*. The temperature of the must at starting was 66°. The day after crushing, one third of a gallon of spirits of 70% strength was added, thus fortifying the must to a strength of 4.6% of alcohol. The maximum temperature of the must was 74°, reached on the fourth day. The wine continued fermenting for fifteen days, when it was fortified with the necessary quantity of spirits. At four months the wine was bright, straw-colored, of medium sweetness, slightly bitter, and not as good as No. 1466. A month later it was racked, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and a half, it differed little from No. 1466, except that it was slightly less acid. At three years and two months it was very good, of excellent flavor and aroma, and maturing well. It was put in glass, and at four years and five months it was brighter and smoother than No. 1466, but otherwise little different.

No. 1485. *Verdelho*, from Paso Robles station. A sample for must analysis was received September 9, 1891, in good condition. The must showed 24.1% of solid contents by spindle and 0.55% of acid.

No. 1518. *Verdelho*, from Mission San José. Received October 19, 1891, in good condition. The must showed 26.05% of solid contents by spindle and 0.71% of acid. The must commenced fermenting at a temperature of 67°, and reached a maximum of 76°, on the fourth day. On the ninth day, while the wine was still sweet, it was fortified.

At three months the wine was bright and clean-tasting; both the acid and the sugar were a little too high. At four months it was racked for the second time, and at five months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and nine months it was bright, of good aroma and flavor, and clean-tasting; it was smooth and agreeable, but a little too sweet. Four months later it had not changed much, had developed little of the Sherry flavor, and the acid was a little too high. At four years and four months it had improved very much, was clean-tasting, and had developed a good aroma; it was a very good Sherry.

No. 1689. *Verdelho*, from Tulare station. Received September 29, 1892, in good condition. The must showed 25.9% of solid contents by spindle and 0.49% of acid The temperature of the grapes at crushing was 72°, and the maximum reached was 79°, on the second day. On the fifth day the wine was fortified.

In ten weeks the wine was bright, but not agreeable. At five months it was racked for the second time, refortified, and sweetened by the addition of a little sugar. When twelve months old it was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and two months it was in good order, showed character, but was not quite clean-tasting, nor equal to Beba and Pedro Jimenes of the same age in smoothness and development. Fourteen months later it had improved and showed marked character, but was still a little raw-tasting.

No. 1859. *Verdelho*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The grapes were small and sweet, and in small, loose bunches. The must showed 26.1% of solid contents by spindle and 0.63% of acid.

No. 1904. *Verdelho*, from Tulare station. Received October 2, 1893, in good condition. The bunches were small, well filled, but not compacted; the berries were large for the variety, and mature. The must showed 25.75% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 86°, on the third day. The wine was fortified on the fifth day.

At two months the wine was bright and of good aroma, but too dry. It was racked for the second time, and at eight months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At eleven months it was racked again, and at fourteen months it was smooth and agreeable, but undeveloped and slightly bitter. At two years and four months it was bright, of good flavor and aroma; a good Sherry, but still rather raw.

No. 2013. *Verdelho*, from Mission San José. A sample for must analysis was received October 26, 1893, in good condition. The bunches were of small to medium size, branching, showing some coulure; the berries small and very sweet. The must showed 28.4% of solid contents by spindle and 0.55% of acid.

No. 2102. *Verdelho*, from Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were small, irregularly conical, with small wings, loose, and showing some coulure; the berries small, pulpy, very sweet, and much past maturity. The must showed 27.7% of solid contents by spindle and 0.44% of acid.

BOAL DE MADEIRA.

(See Vit. Rept. 1883–85, p. 136.)

The variety imported into California under the above name is probably one of the several varieties of Boal which are widely distributed in Portugal. As no adequate descriptions of these varieties are available, it is impossible to say which we have. The chief varieties are the *Boal cachudo* or *commun*, and the *Boal calhariz;* these are grown extensively in many localities, and are generally very productive and satisfactory as to the quality of the wine. The Boal is said to be adapted to divers soils, the grapes ripen early, and are easily injured by wet weather.

Description.—Canes slender and short-jointed; leaves of medium size, longer than broad, with five well-marked sinuses and occasionally two or three secondary ones, lobes overlapping, upper surface with loose, flocculent wool, disappearing at maturity, lower surface closely white-woolly, teeth irregular and acuminate; bunches large, branching, loose;

berries small, ellipsoidal, soft, and juicy, on long and slender pedicels; skin fairly thick, but tender.

The Boal in California has, so far, given small to fair crops, except at Natoma, where it is said to have borne heavily. This is in accordance with the reports from Portugal, where, in some districts, it is considered a heavy bearer, and in others as a light one. It ripens rather later than the Verdelho, and is equally subject to coulure. The average composition of the must has been: at Mission San José and Cupertino, 26.0% of sugar and 0.58% of acid; at Tulare and Fresno, 25.75% of sugar and 0.45% of acid; at Amador, 27.58% of sugar and 0.45% of acid; at Paso Robles, 27.55% of sugar and 0.40% of acid. These figures resemble greatly those found for the Verdelho. It attains a high amount of sugar in all localities, and maintains its acid well. This would indicate its value as a grape for dry Sherries. It would make an excellent blend for this purpose with the Verdelho, which has more character. It makes a rather agreeable sweet wine, but no better, if as good, as several Spanish grapes which are much heavier bearers. Altogether this variety shows few good points in which it is not equaled or surpassed by the Verdelho. It is, however, worthy of further trial in the foothill and southern regions.

ANALYSES OF MUSTS AND WINES.

BOAL DE MADEIRA.		Date of Picking	MUST.				WINE.					
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Body	Ash	Sugar
1884—No. 273.	Natoma Wine Co., Natoma	Sept. 3	21.76	......	.53	......	9.27	11.58	.68	2.00	.26	......
1889—No. 1085.	J. Gallegos, Mission San José	Sept. 16	26.30	26.12	.62	.38	10.44	12.91	.48	2.30	......	......
1890—No. 1300.	J. Gallegos, Mission San José	Oct. 4	25.00	......	.57	.31	13.77*	17.00	.30	3.14	......	1.31
No. 1393.	J. T. Doyle, Cupertino	Oct. 18	27.15	......	.48	......	......	......	......	......	......	......
1891—No. 1473.	Fresno	Aug. 29	26.30	......	.50	.36	17.25*	21.19	.41	3.09	......	3.09
No. 1570.	Mission San José	Oct. 7	26.90	......	.57	......	......	......	......	......	......	......
1893—No. 1873.	Amador station	Sept. 14	25.60	......	.53	......	......	......	......	......	......	......
No. 1951.	Mission San José	Oct. 14	24.80	......	.90	......	......	......	......	......	......	......
No. 1962.	Paso Robles	Oct. 16	26.50	......	.34	......	......	......	......	......	......	......
No. 2095.	Cupertino	Nov. 4	28.40	......	.45	......	......	......	......	......	......	......
1894—No. 2140.	Amador station	Sept. 11	29.55	......	.37	......	......	......	......	......	......	......
No. 2213.	Paso Robles	Sept. 24	28.60	......	.45	......	......	......	......	......	......	......
No. 2248.	Mission San José	Oct. 3	23.70	......	.48	......	......	......	......	......	......	......
No. 2331.	Tulare	Oct. 13	25.20	......	.40	......	......	......	......	......	......	......

* Fortified.

RECORD OF TREATMENT.

No. 1085. *Boal de Madeira*, from Mission San José. Received September 19, 1889, in poor condition; many grapes were dried up. The bunches were rather large, branching, loose; the berries small, ellipsoidal; stems and pedicels long and slender; flesh firm and agreeably flavored; skin thick, but tender. The must showed 26.3% of solid contents by spindle and 0.62% of acid. The yield from the 62.5 lbs. crushed was 4.4 gals., or at the rate of 140 gals. per ton. The temperature of the grapes at crushing was 71°, and the maximum reached was 82.5°, on the third day.

The wine was dry on the sixth day, and was drawn off the thick lees. At three weeks it was almost clear, of agreeable flavor, but slightly bitter. Nine days later it was clear and clean-tasting, and was racked and taken to the cellar. At four months it was in good condition, golden-green in color, of agreeable flavor, and good body, acid, and alcohol. The taste was still a little bitter, but the lees showed no bad germs. At seven months the wine was racked again; it was bright, but had a suspicious taste, and the lees showed some filaments. A month later it had become cloudy, and was pasteurized. After this it did not improve, as the pasteurizing had been done too late and after the flavor had already been impaired. The wine, however, became no worse, and at eighteen months it was distilled.

No. 1300. *Boal de Madeira*, from Mission San José. Received October 7, 1890, in poor condition. The must showed 25.0% of solid contents by spindle and 0.57% of acid. The temperature of the grapes at crushing was 67°, and the maximum reached was 73°, on the third day. On the fifth day the wine was fortified.

At one month the wine was clear, with little flavor or aroma, moderate alcohol and acid, and right amount of sweetness. At three months it was bright and improved, but tasted somewhat bitter, and the spirits had not become well incorporated. It was racked for the second time, and two months later refortified. At seven months it was put in the heating-chamber, at a temperature of 105°, for three months. At sixteen months the wine had much improved, had developed some bouquet, and was of very pleasing flavor. It was racked again, and two years later it had retained its good qualities, but, owing to the smallness of the quantity, it had become too concentrated by evaporation. At four years it was in excellent order, mature and good, but not quite clean-tasting; at this date it was bottled. At five years and four months it was in good condition, full-flavored and mature, with strong "rancio" taste, but lacking in delicacy.

No. 1393. *Boal de Madeira*, from Cupertino. A sample for must analysis was received October 21, 1890, in poor condition, many grapes being crushed and others dried. The must showed 27.15% of solid contents by spindle and 0.48% of acid.

No. 1473. *Boal de Madeira*, from Fresno. Received August 31, 1891, in good condition. The must showed 26.3% of solid contents by spindle and 0.50% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 77°, on the third day. On the sixth day the wine was fortified.

At four months the wine was bright, of good aroma and flavor, and low sugar contents. A month later it was racked for the second time, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months it was bright and of good aroma, but a little bitter. The quantity was too small to keep well. Four months later it had improved a little, and was put in glass. At four years and five months it was in good order, had full aroma and strong "rancio" taste, but was not quite clean-tasting.

No. 1570. *Boal de Madeira*, from Mission San José. A sample for must analysis was received October 9, 1891, in good condition. The must showed 26.9% of solid contents by spindle and 0.57% of acid.

No. 1873. *Boal de Madeira*, from Amador station. A sample for must analysis was received September 16, 1893, in good condition. The bunches were large; the berries rather small and quite ripe. The must showed 25.6% of solid contents by spindle and 0.53% of acid.

No. 1951. *Boal de Madeira*, from Mission San José. A sample for must analysis was received October 14, 1893, in good condition. The bunches were large, loose, and straggling, the berries loose. The must showed 24.8% of solid contents by spindle and 0.90% of acid.

No. 1962. *Boal de Madeira*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in fair condition. The bunches were of medium size, loose, irregularly conical; the berries small, oval, soft and juicy, and quite mature. The must showed 26.5% of solid contents by spindle and 0.34% of acid.

No. 2095. *Boal de Madeira*, from Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, irregularly conical, branching or winged, loose, and coulured; the berries small, oval, soft, and over-ripe. Some of the berries were shriveled. The must showed 28.4% of solid contents by spindle and 0.45% of acid.

MALMSEY.*

(See Vit. Rept. 1883-85, p. 138.)

Synonyms: Malvasia Grossa; Malvoisie à gros grains; Vermentino.

The Malmsey, or Vermentino, is cultivated in northern Portugal, Corsica, and the Island of Madeira for wine, and to a limited extent in the south of France as a table-grape. There are two varieties of Malvoisie cultivated in Madeira, but the one to which the famous Malmsey wine, or Madeira Malvoisie, owed its reputation is a smaller grape of higher quality than the Vermentino. The Vermentino, however, makes an excellent sweet wine, both in Madeira and in Corsica, and is much appreciated as a table-grape in parts of southern France.

Description.—Vine fairly vigorous and very productive in rich soils; canes slender; leaves small to medium, with five deep sinuses and overlapping lobes, the bases of the sinuses looking like four or five roundish holes, after the manner of the Cabernet Sauvignon, upper surface glabrous, lower close woolly; bunches very large and irregular, loose, and with large wings; berries large, oval, appressed at the base; peduncles herbaceous and slender; pedicels much enlarged at the base of the berries, and about three times their length; skin very thin, with light bloom; flesh very juicy, and with delicate Muscat aroma.

This variety has borne well at Tulare with short-pruning; it has shown some tendency to coulure, but the bunches are generally well filled. It ripens rather late, but if given time and not allowed to bear too heavily, will attain a high percentage of sugar. It develops little acid, and this, taken together with its high aroma, makes it very suitable for the manufacture of sweet wines or liqueurs. It can be used also in limited quantities to give aroma to common dry white wines in the hot valleys, when these wines are intended for early consumption. The marked aroma of this grape differs considerably from that of the Muscats, being more delicate and its wine more agreeable. The grape would be excellent for the table but for the delicacy of the skin, which makes it unfit for shipping.

ANALYSES OF MUSTS AND WINES.

MALMSEY.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol		Total Acid as Tartaric, at Six to Eight Months	Body	Ash
						By Weight	By Volume			
1884—No. 275. Natoma	Sept. 7	17.91	......	.56	....	7.92	9.91	.54	1.60	.16
1892—No. 1698. Tulare	Sept. 28	22.40	......	.47	....	......	......	......	......	....
1893—No. 1901. Tulare	Sept. 27	20.60	......	.45	.38	†	......	......	......	....
No. 1959. Paso Robles	Oct. 12	25.90	......	.33	....	......	......	......	......	....
1894—No. 2286. Tulare	Oct. 6	23.15	21.80	.34	....	......	......	......	......	....

RECORD OF TREATMENT.

No. 1698. *Malmsey*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The grapes were large and thin-skinned. The must showed 22.4% of solid contents by spindle and 0.47% of acid.

No. 1901. *Malmsey*, from Tulare station. Received September 29, 1893, in good condition. The bunches were very large (most of them had been broken up for convenience of packing) and irregular, loose, with large wings, showing some coulure; the berries were large, oval, appressed at the base; peduncles herbaceous and slender; pedicels much enlarged at base of berries, which are about three times their length; skin very thin, with light bloom; flesh very juicy, with delicate Muscat aroma. The must showed 20.6% of solid contents by spindle and 0.45% of acid. The grapes were fermented with No. 1900, Pedro Jimenes.

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* Corruption of Malvoisie, but not the grape so called in California.

† See No. 1900, Pedro Jimenes.

No. 1959. *Malmsey*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in fair condition. The bunches were large, conical, loose; the berries ovoid, juicy, thin-skinned, very well flavored. The must showed 25.9% of solid contents by spindle and 0.33% of acid.

WEST'S WHITE PROLIFIC.

(See Vit. Rept. 1885–86, p. 108.)

The true name of this variety has not yet been ascertained, but under its California name (derived from its introduction by Mr. W. B. West, of San Joaquin County) it has been rather widely distributed, and is planted in notable quantities in many California vineyards.

Description.—Vine vigorous; canes light brown and rather slender; leaves of good size, without or with only two shallow sinuses, glabrous above, loose-woolly beneath, with very short obtuse teeth; bunches medium to large, long conico-cylindrical, loose or compact, occasionally shouldered; berries of medium size, slightly ovoid, juicy, and of neutral flavor.

This variety has been somewhat extensively recommended as a brandy and as a Sherry grape. For the production of brandy there can be no doubt of its value for certain localities. It is an excellent bearer in rich soils, and maintains a good amount of acid, even in the hottest localities. It ferments well, and its neutral character and the absence of any marked aroma render it eminently suitable for the production of light, neutral blending wines in the San Joaquin Valley. For the production of Sherries or other sweet wines, however, it cannot now be recommended in the presence of several much superior grapes. The average composition of the must has been: at Cupertino and Mission San José, 23.2% of sugar and 0.76% of acid; at Fresno and Tulare, 25.1% of sugar and 0.62% of acid; at Paso Robles, 24.7% of sugar and 0.56% of acid; at Amador station, 25.2% of sugar and 0.75% of acid. These figures show that this variety is one of the best we have for maintaining a full amount of acid with high sugar in the warmer parts of the State. While this is a great advantage in the fermentation and handling of the wine when made dry, it detracts from its value when made into a sweet wine. The sweet wines which we have made from it are harsh and lacking in quality. At best they are but neutral blending wines.

TABLE OF PRODUCTION.

WEST'S WHITE PROLIFIC.	Number of Vines.....	Total Weight of Grapes, in lbs.	Average per Vine, in lbs.	Date of Picking ....
1887—No. 695 (long-pruned). J. T. Doyle, Cupertino...	20	332	16.6	Oct. 5
No. 749 (short-pruned). J. T. Doyle, Cupertino..	20	100	5.0	Oct. 18
1888—No. 942 (short-pruned). J. T. Doyle, Cupertino..	18	395	21.9	Oct. 25
No. 943 (long-pruned). J. T. Doyle, Cupertino...	20	430	21.5	Oct. 25
1889—No. 1154. J. T. Doyle, Cupertino....................	20	550	27.5	Oct. 9

ANALYSES OF MUSTS AND WINES.

WEST'S WHITE PROLIFIC.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Sugar
						By Weight	By Volume				
1886—No. 500. J. T. Doyle, Cupertino	Sept. 27	20.00	18.89	1.00	.26	7.50	9.36	.77		2.35	
No. 505. J. T. Doyle, Cupertino	Sept. 27	19.80		.91		7.71	9.65	.69		2.05	
1887—No. 695 (long-pruned). J. T. Doyle, Cupertino	Oct. 5	23.69	24.01	.78	.27	9.05	11.27	.54	.15	2.60	
No. 749 (short-pruned). J. T. Doyle, Cupertino	Oct. 18	26.16	25.19	.66	.44	10.35	12.82	.48	.10	2.60	
1888—No. 942 (short-pruned). J. T. Doyle, Cupertino	Oct. 25	25.95	26.99	.48	.37	10.35	12.80	.46			
No. 943 (long-pruned). J. T. Doyle, Cupertino	Oct. 25	25.02	25.76	.60	.28						
1889—No. 1045. Margherita Vineyard, Fresno	Sept. 2	28.30	28.07	.43	.49						
No. 1154. J. T. Doyle, Cupertino	Oct. 9	25.90		.65							
1890—No. 1238. Margherita Vineyard, Fresno	Aug. 22	25.20	25.76	.57	.31						
No. 1271. J. T. Doyle, Cupertino	Sept. 29	20.60		.86	.31						
1891—No. 1465. Fresno	Aug. 28	25.65		.56		*15.25	18.78	.33		2.85	
No. 1531. Paso Robles	Oct. 6	24.60		.54							
1892—No. 1640. Tulare	Sept. 12	24.35	23.23	.62	.50	*14.82	18.25	.52		2.70	1.50
No. 1754. Paso Robles	Oct. 11	24.10		.57							
1893—No. 1872. Amador station	Sept. 16	22.20		1.03							
No. 1903. Tulare	Oct. 1	22.40	20.99	.77	.47	8.70	10.83	.44		2.60	
No. 1903*a*. Tulare	Oct. 1						16.20	.68		2.82	.98
No. 2034. Cupertino	Nov. 1	21.50		.92							
No. 2069. Paso Robles	Nov. 1	25.45	24.64	.58	.32		19.35	.47		2.85	
1894—No. 2186. Amador station	Sept. 25	25.90		.70							
No. 2221. Tulare	Oct. 1	24.80	22.67	.76							
No. 2222. Amador station	Oct. 1	27.60		.53							

*Fortified.

RECORD OF TREATMENT.

No. 696. *West's White Prolific*, from Cupertino. Received October 6, 1887, in good condition, and crushed the following day. The bunches were long, loose, and slender, very little affected by coulure; the berries were greenish, bronzed like the Palomino where exposed to the sun. The must showed 23.69% of solid contents by spindle and 0.78% of acid. Fermentation commenced the day of crushing, and reached its maximum temperature of 89°, on the second day. The 110.7 lbs. crushed yielded 8.7 gals., or at the rate of 156 gals. per ton.

At three weeks the wine was drawn off the thick lees. At two months it was bright, thin-bodied, and with high acid; it had less bouquet than No. 749, the sample from short-pruned vines. A microscopic examination of the lees showed acetic germs; the wine was racked again and pasteurized. At seven months it had improved very much, was heavy-bodied, clean-tasting, with pleasant Sherry flavor and well-developed bouquet. At fifteen months it was distilled for brandy.

No. 749. *West's White Prolific*, from Cupertino. Received October 19, 1887, in good condition, and crushed the day of arrival. The bunches were generally well filled, but a few showed a little early coulure; the berries were good and of full size, except for a few abortive ones. The must showed 26.16% of solid contents by spindle and 0.66% of acid. The fermentation reached its maximum on the third day at a temperature of 83°. The yield from 83 lbs. was 6.0 gals., or at the rate of 165 gals. per ton.

In two weeks the wine was drawn off the thick lees and divided into two packages: one of four gallons for dry wine, and the other of two gallons for Sherry. To the latter was added sufficient alcohol to bring it up to 18%, and the sample was put into the heating-chamber, at a temperature of 80°. In two months No. 749 (dry wine) was in good condition, bright, with medium acid and some bouquet. A month later it was racked and pasteurized. At eight months it was a very good wine with low acid, marked flavor, and well-developed bouquet—a promising wine for distillation. At fifteen months it was distilled for brandy. At four months No. 749*a* (Sherry sample) had improved very much. At eight months it was in good order and possessed a good Sherry aroma, but was quite dry. It was sweetened to 5% by the addition of rock-candy. The wine improved and made a good Sherry, but was somewhat deficient in alcohol.

No. 942. *West's White Prolific*, from Cupertino. Received October 26, 1888, in good condition. The grapes were from both long and short-pruned vines, the former looking the best. A few berries were dried up, but they were not generally overripe. The effect of a little coulure was noticeable. The must showed 25.95% of solid contents by spindle and 0.48% of acid. The grapes were crushed the day they arrived, and yielded must at the rate of 159 gals. per ton.

At one month the wine was racked and taken to the cellar. At three months it was clear, good, with pleasing aroma and advanced development. Two months later it was racked again. The lees were examined microscopically at five, sixteen, and twenty-one months, respectively, and no unsound ferments found. At fifteen months the wine was bright, with full and agreeable bouquet and well-developed flavor, but not yet bottle-ripe. At seventeen months it was racked again. At twenty-one months it was bright and good and nearly mature. A month later it was bottled. At two years and five months some wine that had been bottled at five months was examined; it was bright, smooth, and clean-tasting, with full flavor and some bouquet. That bottled at twenty-two months was little different, but with a little less flavor. Eighteen months later the earlier bottled wine had deteriorated, while the later had improved and was very good. At seven years the second bottling was a smooth, pleasing wine, with little bouquet or character.

No. 1045. *West's White Prolific*, from Fresno. A sample for must analysis was received September 5, 1889. The bunches were of medium size or larger, cylindrical, sometimes shouldered; the berries medium sized, firm, and juicy. The must showed 28.3% of solid contents by spindle and 0.43% of acid.

No. 1154. *West's White Prolific*, from Cupertino. A sample for must analysis was received October 10, 1889, in good condition, and mature. The bunches were large, not very compact, cylindrical, and sometimes shouldered. The must showed 25.9% of solid contents by spindle and 0.65% of acid.

No. 1238. *West's White Prolific*, from Fresno. A sample for must analysis was received August 25, 1890, in good condition, but many of the berries dried. The must showed 25.2% of solid contents by spindle and 0.57% of acid.

No. 1271. *West's White Prolific*, from Cupertino. A sample for must analysis was received October 2, 1890, in good condition, but small, tasteless, and unripe. The must showed 20.6% of solid contents by spindle and 0.86% of acid.

No. 1465. *West's White Prolific*, from Fresno. Received August 31, 1891, in good condition. The must showed 25.65% of solid contents by spindle and 0.56% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 74°, on the fourth day. The fermentation was very slow, and on the eighth day was stopped by the addition of spirits.

At four months the wine was bright, with good aroma, and slight sweetness. The next month it was racked for the second time, and at six months put in the hot-box, at a temperature of from 90° to 95°, for three months. At two years and ten months it was a fair but coarse Sherry, without much flavor or aroma. Four months later it had improved, and was put in glass and loosely corked. At four years and five months it was a coarse Sherry that would be useful as a blend with a smooth, full-flavored wine. It had acquired a very marked "rancio" taste.

No. 1531. *West's White Prolific*, from Paso Robles station. A sample for must analysis was received October 8, 1891, in good condition. The bunches were small and compact; the berries small, round-oval, mature. The must showed 24.6% of solid contents by spindle and 0.54% of acid.

No. 1640. *West's White Prolific*, from Tulare station. Received September 15, 1892, in good condition. The must showed 24.35% of solid contents by spindle and 0.62% of acid. The temperature of the grapes at crushing was 64°, and the maximum reached was 77°, on the fourth day. The wine was fortified on the fifth day.

In one month the wine was clear and was racked. At three months it was bright and promising, with low acid and slight sweetness. At six months it was refortified and sweetened by the addition of a little rock-candy, racked, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At ten months it was bright, clean-tasting, and neutral. At two years and three months the wine was in good order—a good, clean-tasting, rather thin wine, with little character, but without any positive defects. Blended with one quarter of No. 1619 (Marsanne) it made a good Sherry. At three years and five months it had improved, showed good flavor and aroma, but was rather too high in acid and lacked smoothness.

No. 1754. *West's White Prolific*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 24.1% of solid contents by spindle and 0.57% of acid.

No. 1872. *West's White Prolific*, from Amador station. A sample for must analysis was received September 16, 1893, in good condition, but not mature. The bunches were small, the berries of medium size. There was evidence of some coulure. The must showed 22.2% of solid contents by spindle and 1.03% of acid.

No. 1903. *West's White Prolific*, from Tulare station. Received October 2, 1893, in good condition, and nearly mature, but with a good deal of acid. The bunches were small and rather loose, the berries of medium size. The must showed 22.4% of solid contents by spindle and 0.77% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 87°, on the third day. On the fifth day the wine was still a little sweet, and five gallons were drawn off and fortified. The rest was fermented out dry.

No. 1903 (dry wine). In five weeks the wine was clear and clean-tasting. It was racked and taken to the cellar. At four months it was bright, with little flavor, no aroma, and a slight bitterness. A month later it was racked again, and at six months it showed no improvement; it was flat and without character. At ten months it was no better, and the lees showed some acetic germs; it was racked again and part put in bottle. At thirteen months it was slightly better; it had more body and less acid than the Burger from Tulare, but was inferior to the latter in quality. At nineteen months it was bottled. At two years and four months it was bright and without deposit, lacking in bouquet and flavor, but sound and fairly agreeable.

No. 1903*a* (fortified). At two months it was bright, but too dry. It was racked for the second time, and at five months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At nine months it was racked again, and at two years and four months it was in good order, but a dry and tasteless wine of poor quality.

No. 2034. *West's White Prolific*, from Cupertino. A sample for must analysis was received October 31, 1893, in good condition, but not quite mature. The bunches were of medium size, long, conico-cylindrical, close to compact; the berries of medium size, juicy, thin-skinned, and with full acid. The must showed 21.5% of solid contents by spindle and 0.92% of acid.

No. 2069. *West's White Prolific*, from Paso Robles station. Received November 3, 1893, in fair condition. The bunches were small to medium, well filled, conico-cylindrical, with or without shoulders, sometimes branching; the berries under medium in size, slightly oval, soft and juicy, not quite mature. The must showed 25.45% of solid contents by spindle and 0.58% of acid. The temperature of the grapes at crushing was 69°, and the maximum reached was 78°, on the third day. On the eighth day the wine was fortified.

In five weeks the wine was bright, but too dry. It was racked for the second time, and at four months was put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At eight months it was racked again. At fifteen months it was in good order, rather too dry, of fair aroma and some Sherry taste, but lacking in delicacy and smoothness.

FEHER SZAGOS.

This variety, like the West's White Prolific, was imported from Europe and the name lost. It was presumed, for some reason, to be a Hungarian grape, and in California was given its present name, which is the Hungarian for white grape.

Description.—Vine strong-growing in rich soils, and very productive; leaves small to medium, roundish, generally three-lobed, and with shallow sinuses, glabrous above and nearly so beneath; bunches large, long, and narrow; berries oblong, pendent, loosely placed on long pedicels; skin thin and tender, covered with brown dots; flesh firm.

This vine is an extremely heavy bearer at Fresno with short-pruning. The grapes attain a good percentage of sugar when the crop is not too large, and are low in acid. They have, however, very little character, and make at best a neutral, cutting Sherry. Their lack of acid and character makes them quite unsuited to the production of dry wine.

The fermentation is remarkably slow and steady, but shows little tendency to "go wrong."

Analyses of Musts and Wines.

FEHER SZAGOS.	Date of Picking	MUST.				WINE.						
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months	Volatile Acid	Body	Ash	Sugar
1881—No. 24. G. Eisen, Fresno	....	17.15	19.54	.32	.....	8.54	8.22	.56	.....	1.68	.39	.....
No. 25 G. Eisen, Fresno	....	17.15	19.54	.32	.....	10.60	10.20	.53	.....	1.99	.44	.....
1887—No. 798.† Margherita Vineyard, Fresno	Nov. 11	26.81	26.99	.17	.68	7.78	9.73	.77	.36	.....	.....	.....
1890—No. 1213. Margherita Vineyard, Fresno	Aug. 22	22.40	21.97	.40	.40	.....	.....	.....	.....	.....	.....	.....
1891—No. 1503. Fresno	Sept. 20	23.70	23.62	.32	.....	*15.50	19.08	.39	.....	2.38	.....	1.42

*Fortified. †Overripe.

RECORD OF TREATMENT.

No. 798. *Feher Szagos*, from Fresno. Received November 14, 1887, in fair condition, overripe and flabby, but generally sound. The bunches were long and narrow, occasionally shouldered; the berries were large, oblong, pendent, loosely placed on long pedicels; the skin was thin and tender, covered with brown dots; the flesh was solid and gelatinous. About 15% of the grapes were half-raisins; they tasted very astringent for a white grape. The must showed 26.81% of solid contents by spindle and 0.17% of acid. The grapes (125 lbs.) were thoroughly crushed and the mash aërated from time to time for twenty-four hours, when it was pressed. On the second day after crushing the fermentation was so slow that the must was put in the heating-chamber, at a temperature of 85°. It fermented slowly and its temperature did not rise above the temperature of the room.

At one month the wine was drawn off the thick lees and left in the hot chamber. At two months wine-flowers appeared and the wine had a slight acetic smell, so it was drawn off and pasteurized. At this date it had 9% of solid contents and it was fortified up to 18% of alcohol. A month later it was bright and improved, but quite neutral and too sweet. At eight months it was in good order and had improved in bouquet and in quality generally.

No. 1213. *Feher Szagos*, from Fresno. A sample for must analysis was received August 25, 1890, in poor condition. The grapes were quite ripe, and the must showed 22.4% of solid contents by spindle and 0.40% of acid.

No. 1503. *Feher Szagos*, from Fresno. Received September 25, 1891, in good condition. The must showed 23.7% of solid contents by spindle and 0.32% of acid. The temperature of the grapes at crushing was 70°, and the maximum reached was 77°, on the third day. The fermentation was very slow, and it was not till the eighteenth day that the wine was dry enough to fortify.

At three months the wine was clear, fresh, and clean-tasting, with rather high sweetness. At five months it was racked for the third time, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months it was bright, a perfectly neutral wine, without positive defects, but lacking altogether in flavor and aroma. It would make an excellent neutral blend with some highly flavored Sherry. Four months later it was put in glass; it was very clean-tasting, but without character. At four years and five months it was well advanced toward maturity, was smooth and clean-tasting, but showed little flavor or aroma.

MUSCATEL.

(See Vit. Rept. 1885, p. 103.)

Synonyms: Muscat blanc de Frontignan; White Frontignan; Muskateller; Weisse Muscattraube; Moscatello bianco.

Description.—Vine of medium size, with strong, spreading canes; canes reddish-brown, with short internodes; leaves of medium size, thin, five-lobed, glabrous, except for a few hairs on the lower side of the well-marked ribs; bunches long, cylindrical, regular, compact; berries round, golden-yellow, becoming amber-colored, very sweet and of marked aroma. Ripens a little later than the Chasselas.

The Muscatel in some one of its many forms is cultivated in almost every country where vines are grown. It is highly esteemed as an early table-grape wherever its poor shipping qualities do not preclude its use; several forms, such as Silver Frontignan, Auvergne Frontignan, Grisely Frontignan, are grown in English hothouses. The Muskateller is grown widely, but not in large quantities, all over Austria, Hungary, and parts of Germany, where it is used principally as an addition to neutral grapes lacking in aroma. In Italy several yellowish and pinkish variations are grown. In southern countries the berries are larger, but the aroma is less marked than in cooler climates. The principal importance of the Muscatel comes from the fact that from it are made the famous "vins de liqueur" of Frontignan in southern France. In making these wines the grapes are allowed to remain on the vines till they have reached the last stages of ripening or even have become half-raisins. These wines are held in such high esteem that it is worth while to attempt to reproduce them in California. In fact, some very creditable sweet Muscatel has already been made here, but it must be kept in mind that only from grapes grown on dry hillsides and allowed to reach the last stages of maturity can anything approaching the wines of Frontignan be made.

The Muscatel should not be planted in situations liable to spring frosts, on account of the early starting of the buds. Like many varieties of ancient origin, it is liable to degenerate and give rise to sports that produce abortive berries without seeds and about the size of peas. On this account great care should be exercised in the choice of cuttings. On account of the peculiar attractive aroma of this grape it is more subject to the attacks of animals and insects than any other. Deer and rabbits will single out a vine of this variety from a whole vineyard for their attacks. Insects are so partial to the grapes that the Romans, who had several varieties of Muscat, called them "Apianæ," from "apis," a bee. Our modern name of Muscat has a similar signification, being derived from the Latin "musca," a fly.

Though the Muscat flavor is in such high repute for "vins de liqueur" in Europe, it seems somewhat discredited in California. This is doubtless due to the use of the Muscat of Alexandria, which is much inferior to the Muscatel for this purpose. The natural aroma of all grapes is strongest in the wine when it is new, and in time becomes feebler, and at last is completely lost. The Muscatel has the most pronounced and the most persistent of all grape aromas, and the wine does not completely lose it for twelve or more years. As the natural aroma disappears, the wine acquires a "gout de rance," which is very delicate and agreeable.

ANALYSES OF MUSTS.

MUSCATEL.	Date of Picking	MUST.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash
1889—No. 1024. Fresno	Aug. 31	25.00	25.19	.42	.47
1890—No. 1215. Fresno	Aug. 23	23.30	23.13	.41	.34
1893—No. 1963. Paso Robles	Oct. 12	29.65	....	.34	......
No. 1998. Tulare	Oct. 17	26.95	....	.47	......

RECORD OF TREATMENT.

No. 1024. *Early Silver Frontignan*, from Margherita Vineyard, Fresno. Grapes arrived September 2, 1889, in fair condition, but only in small quantity for must analysis. Bunches large, pyramidal, and winged; grapes medium size, close, round, and golden-green colored; flesh soft, with a strong Muscat flavor; skin thin and easily broken. Juice showed 25.0% of solid contents and 0.42% of acid.

No. 1215. *Early Silver Frontignan*, from Fresno. A sample for must analysis was received August 25, 1890, in bruised condition. The grapes were very ripe, but only showed 23.3% of solid contents by spindle and 0.41% of acid.

No. 1963. *Muscatel*, from Paso Robles station. A sample for must analysis was received October 14, 1893, in good condition. The bunches were of medium size, close, cylindrical, with or without a small shoulder or wing; the berries were round, of medium size, overripe, commencing to dry up. The grapes were from long-pruned vines growing in sandy soil and bearing a very small crop—about one and a half tons per acre. The must showed 29.65% of solid contents and 0.34% of acid.

No. 1998. ***Muscatel***, from Tulare station. A sample for must analysis was received October 19, 1893, in good condition. The grapes were a mixture of first and second crop. The first was overripe and dried up, while the second was not quite ripe. The must showed 26.95% of solid contents by spindle and 0.47% of acid.

MALVASIA BIANCA.

Synonym: Malvoisie blanche du Piedmont.

Description.—Vine fairly vigorous, with light-brown wood; leaves three-lobed, with shallow sinuses, glabrous above, woolly beneath, with short, sharp teeth; bunches over average in size, conico-cylindrical, winged, well filled but not compressed, on long, thin peduncles; berries round, small to average in size, with thick, tough skin and light bloom, color green, with a pinkish tint on the ripest grapes, flesh soft and juicy, with a delicate Muscat aroma.

This variety is widely cultivated in Piedmont and is used for the production of sweet wines and "vins de liqueur." At Asti, Italy, it is employed to some extent in the production of sparkling wines. It is an agreeable eating-grape with a delicate Muscat flavor, but is too soft and juicy to be grown extensively for this purpose.

ANALYSES OF MUSTS.

MALVASIA BIANCA.	Date of Picking	Solid Contents by Spindle	Acid as Tartaric
1890—No. 1360. Cupertino	Oct. 17	26.10	.65
1891—No. 1532. Paso Robles	Oct. 6	26.95	.31
1892—No. 1756. Paso Robles	Oct. 11	26.50	.24
1893—No. 2105. Cupertino	Nov. 5	25.90	.74

RECORD OF TREATMENT.

No. 1360. ***Malvasia bianca***, from Cupertino. Received October 17, 1890, in good condition, but rather softened by the rain. The bunches were over average in size, conico-cylindrical, well filled, but not compressed; the berries were round, small to average, on long, thick pedicels; the skin was thick, tough, with a light bloom and of a pinkish color. The must showed 26.1% of solid contents by spindle and 0.65% of acid. The temperature of the grapes at crushing was 66°, and the maximum reached was 79°, on the fourth day. On the seventh day the wine was dry and was racked off.

At one month the wine was bright, of slightly pinkish tint, strong aroma, full flavor, clean taste, medium acid, and, in general, of good quality. A month later it was racked for the second time. At two and at three months the lees were examined and no unsound germs found. At three months the wine was still in good condition; it was racked for the third time; it was full-bodied and with high alcohol, but still tasted raw. Two months later the lees showed some unsound germs and the wine was pasteurized. At seven months it was bright, maturing well, with strong flavor and aroma. At fifteen months it was bright, with rich Muscat aroma, fresh and clean taste, nearly mature. Eight months later it was bottled. At three years the bottled wine had deteriorated and made a heavy deposit in bottle; it had been bottled too soon.

No. 1532. ***Malvasia bianca***, from Paso Robles. A sample for must analysis was received October 8, 1891, in fair condition, but a little moldy. The bunches and grapes were of average size; the berries thin-skinned and tender. The grapes were mature, and the must showed 26.95% of solid contents by spindle and 0.31% of acid.

No. 1756. ***Malvasia bianca***, from Paso Robles. A sample for must analysis was received October 13, 1892, in good condition. The must showed 26.5% of solid contents by spindle and 0.24% of acid.

No. 2105. ***Malvasia bianca***, from Cupertino. A sample for must analysis was received November 7, 1893, in good condition. The bunches were of medium size, conico-cylindrical, slightly shouldered; the berries of medium size, soft, juicy, with thick skins, and a delicate Muscat aroma. The must showed 25.9% of solid contents by spindle and 0.74% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SHERRY AND MADEIRA TYPE.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Pedro Jimenes.								
266	Natoma	1884	20.78	20.61	.33	.40	12.00	.56	1.18
484	Natoma	1886	19.30	18.89	.38	.35	9.73	.59	2.00
784	Cupertino	1887	21.26	20.61	.45	.40	9.36	.68	2.30
953	Cupertino	1888	19.40	19.59	.35	.48	9.54	.36	2.40
1191	Cupertino	1889	20.06	......	.25	.41	*17.70	.21	4.00
1404	Cupertino	1890	19.70	......	.47	.23	*17.20	.33	2.08
2036	Cupertino	1893	23.70	......	.47	......	......	......	......
1244	Fresno	1890	21.20	20.39	.41	.61	*20.06	.30	2.77
1502	Fresno	1891	23.70	23.13	.45	......	*19.08	.30	2.61
1502*a*	Fresno	1891	23.70	23.13	.45	......	*20.06	.27	......
1352	Mission San José	1890	22.80	......	.42	......	*17.40	.34	2.48
1606	Mission San José	1891	24.80	......	.49	.37	*21.19	.20	3.31
1779	Mission San José	1892	23.15	22.67	.50	......	11.55	.53	2.60
2246	Mission San José	1894	22.30	......	.42	......	......	......	......
1670	Tulare	1892	22.60	21.38	.33	.47	*18.25	.38	2.55
1900	Tulare	1893	22.20	21.80	.41	.43	......	......	......
2350	Tulare	1894	23.90	......	.29	......	......	......	......
1853	Amador station	1893	19.30	......	.53	......	......	......	......
2164	Amador station	1894	21.50	......	.58	......	......	......	......
1916	Paso Robles	1893	21.50	21.00	.40	.38	*18.25	.35	2.85
2214	Paso Robles	1894	21.50	......	.49	......	......	......	......
	Average, Natoma	......	**20.04**	**19.75**	**.36**	**.38**	**10.86**	**.58**	**1.59**
	Average, Cupertino	......	**20.82**	**20.25**	**40**	**.38**	**9.45**	**.52**	**2.35**
	Average, Fresno	......	**22.87**	**22.22**	**.43**	**.61**	......	**.27**	......
	Average, Mission San Jose	......	**23 14**	**22.67**	**.46**	**.37**	......	**.36**	......
	Average, Tulare	......	**22.90**	**21.59**	**.34**	**.45**	......	**.38**	......
	Average, Amador station	......	**20.40**	......	**.56**	......	......	......	......
	Average, Paso Robles	......	**21.50**	**21.00**	**.45**	**.38**	......	**.35**	......
	Palomino.								
504	Cupertino	1886	16.30	15.68	.53	.27	8.00	.59	1.55
765	Cupertino. (Long-pruned)	1887	23.09	22.67	.42	.44	12.18	.44	2.60
698	Cupertino. (Long-pruned)	1887	19.57	19.75	.37	.38	9.36	.49	2.10
728	Cupertino. (Short-pruned)	1887	23.30	22.67	.47	.37	12.09	.47	2.60
952	Cupertino	1888	21.57	22.67	.18	.36	10.91	.52	2.05
951	Cupertino	1888	21.39	21.80	.24	.34	10.36	.42	2.30
1198	Cupertino	1889	23.70	23.13	.22	.42	11.27	.39	1.95
1311	Cupertino	1890	20.85	......	.43	.27	11.73	.38	2.10
1397	Cupertino	1890	24.60	......	.31	......	......	......	......
2067	Cupertino	1893	24.80	......	.47	......	......	......	......
547	Missión San José	1886	23.70	......	.55	......	......	......	......
727	Mission San José. (Long pruned)	1887	22.00	20.85	.35	.40	11.09	.47	2.40
1171	Mission San José	1889	23.05	23.13	.38	.33	*19.00	.32	3.01
1423	Mission San José	1890	28.00	......	.34	......	......	......	......
1519	Mission San José	1891	25.45	......	.53	......	......	......	......
1780	Mission San José	1892	20.50	19.75	.55	......	10.25	.59	2.55
2019	Mission San José	1893	22.90	21.38	.61	.35	*17.70	.48	4.30
2251	Mission San José	1894	22.40	......	.41	......	......	......	......
267	Natoma	1884	23.86	23.81	.32	.40	13.50	.53	1.85
384	San José	1885	......	......	......	......	13.00	.57	2.18
683	Livermore	1887	22.60	22.58	.38	.40	11.36	.47	2.40
1041	Fresno	1889	25.00	25.19	.18	.65	*17.20	.44	2.35
1239	Fresno	1890	23.92	23.42	.34	.33	*18.25	.25	2.48
1476	Fresno	1891	24.10	23.62	.36	.48	*20.00	.11	2.45
1654	Paso Robles	1892	21.30	20.21	.39	.31	*19.28	.38	2.55
1671	Tulare	1892	23.70	22.67	.32	.48	*18.98	.37	2.55
1843	Tulare	1893	21.95	20.24	.38	.52	*18.88	.32	4.00

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* Fortified.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SHERRY AND MADEIRA TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric.	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Palomino—Continued.								
1979	Tulare	1893	23.70	22.23	.26	.39			
2154	Tulare	1894	24.00		.28				
2292	Tulare	1894	24.60	24.01	.26				
1875	Amador station	1893	20.60		.47				
2165	Amador station	1894	24.05	22.67	.44				
2166	Amador station	1894	24.40	23.13	.38				
	Average, Cupertino		**21.92**	**21.19**	**.36**	**.36**	**10.74**	**.46**	**2.16**
	Average, Mission San Jose		**11.00**	**21.28**	**.46**	**.36**	**10.67**	**.53**	**2.47**
	Average, Fresno		**24.34**	**24.08**	**.29**	**.49**			
	Average, Tulare		**23.59**	**22.29**	**.30**	**.46**			
	Average, Amador station		**23.02**	**22.90**	**.43**				
	Beba.								
271	Natoma	1884	22.60		.25		14.27	.50	2.10
1676	Tulare	1892	23.70		.26		*19.18	.38	2.92
1816	Tulare	1893	21.05	20.61	.38	.67	*17.20	.41	2.90
2169	Tulare	1894	24.80	24.12	.26				
1854	Amador station	1893	22.60		.47				
2163	Amador station	1894	25.20		.38				
1965	Paso Robles	1893	27.21		.29				
	Average, Tulare		**23.18**	**22.37**	**.30**	**.67**	***18.19**	**.40**	**2.91**
	Average, Amador station		**23.90**		**.43**				
	Perruno.								
268	Natoma	1884	22.76		.31	.31	12.35	.52	1.95
1687	Tulare	1892	22.60	22.23	.29	.40	*19.96	.28	2.48
1905	Tulare	1893	22.20	20.61	.41	.34	*19.00	.48	2.88
2289	Tulare	1894	22.85	22.04	.35				
1874	Amador station	1893	18.40		.51				
2184	Amador station	1894	24.10		.39				
1958	Paso Robles	1893	26.30		.15				
	Average, Tulare		**22.55**	**21.63**	**.35**	**.37**	***19.48**	**.38**	**2.65**
	Average, Amador station		**21.25**		**.45**				
	Mantuo de Pilas.								
269	Natoma	1884	18.63		.35		9.82	.53	1.32
477	Natoma	1885	20.40	20.02	.37	.42	9.73	.45	
497	Natoma	1885	20.40		.28		10.58	.35	
1688	Tulare	1892	23.50	23.42	.37	.58	*18.03	.31	2.53
1966	Tulare	1893	21.50	20.17	.38	.48	*17.50	.35	3.30
2332	Tulare	1894	23.30	22.23	.32				
1877	Amador station	1893	19.30		.50				
2182	Amador station	1894	22.10		.40				
1957	Paso Robles	1893	22.75		.30				
	Average, Natoma		**19.81**	**20.02**	**.47**	**.42**	**10.06**	**.44**	**1.32**
	Average, Tulare		**22.77**	**21.94**	**.36**	**.48**			
	Average, Amador station		**20.70**		**.45**				
	Mourisco branco.								
270	Natoma	1884	22.60		.25		14.27	.50	2.10
482	Natoma	1885	25.10	24.97	.31	.40	12.54	.33	
1716	Tulare	1892	23.40		.33				
1970	Tulare	1893	23.50	21.80	.32	.34	*19.08	.30	3.10
2312	Tulare	1894	22.60		.30				
1876	Amador station	1893	18.20		.60				
2183	Amador station	1894	20.00		.49				
	Average, Natoma		**23.85**	**24.97**	**.28**	**.40**	**13.40**	**.42**	**2.10**
	Average, Tulare		**23.17**	**21.80**	**.32**	**.34**			
	Average, Amador station		**19.10**		**.54**				

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*Fortified.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SHERRY AND MADEIRA TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	Verdelho.								
272	Natoma	1884	27.35	25.88	.50	.37	*15.20	.42	2.82
568	Mission San José	1886	26.90		1.00				
838	Mission San José	1888	26.42		.57				
914	Mission San José	1888	28.22		.34	.32	*15.20	.41	2.95
1297	Mission San José	1890	25.90		.71	.22	*16.98	.72	3.06
1518	Mission San José	1891	26.05	26.99	.71		*19.78	.51	3.80
2013	Mission San José	1893	28.40	27.70	.55	.30			
2249	Mission San José	1894	24.60		.55				
766	Cupertino	1887	30.04	31.48	.49	.45			
867	Cupertino	1888	24.15	24.33	.46	.26	12.27	.64	2.70
1100	Cupertino	1889	26.90	26.99	.54	.40	13.27	.44	2.86
1322	Cupertino	1890	27.65		.55				
2102	Cupertino	1893	27.70		.44				
1203	Fresno	1890	24.10	24.64	.65	.52	*18.22	.55	2.96
1466	Fresno	1891	29.10		.54		*20.71	.45	2.99
1451	Tulare	1891	26.30		.56				
1689	Tulare	1892	25.90	27.65	.49		*20.24	.36	2.95
1904	Tulare	1893	25.75	25.76	.58	.43	*19.90	.53	3.10
2220	Tulare	1894	27.15	26.31	.49				
1485	Paso Robles	1891	24.10		.55				
2219	Paso Robles	1894	26.06		.66				
1859	Amador station	1893	26.10		.63				
2180	Amador station	1894	27.35		.45				
	Average, Mission San Jose		**26.49**	**27.34**	**.57**	**.28**			
	Average, Cupertino		**27.29**	**27.60**	**.49**	**.37**	**12.77**	**.54**	**2.78**
	Average, Fresno		**27.43**	**24.64**	**.58**	**.52**			
	Average, Tulare		**26.27**	**26.57**	**.53**	**.43**			
	Average, Paso Robles		**25.08**		**.60**				
	Average, Amador station		**26.72**		**.54**				
	Boal de Madeira.								
273	Natoma	1894	21.76		.53		11.58	.66	2.00
1085	Mission San José	1889	26.30	26.12	.62	.38	12.91	.48	2.30
1300	Mission San José	1890	25.00		.57	.31	*17.00	.30	3.14
1570	Mission San José	1891	26.90		.57				
1951	Mission San José	1893	24.80		.90				
2248	Mission San José	1894	23.70		.48				
1393	Cupertino	1890	27.15		.48				
2095	Cupertino	1893	28.40		.45				
1473	Fresno	1891	26.30		.50	.36	*21.19	.41	3.09
1873	Amador station	1893	25.60		.53				
2140	Amador station	1894	29.55		.37				
1962	Paso Robles	1893	26.50		.34				
2213	Paso Robles	1894	28.60		.45				
2331	Tulare	1894	25.20		.40				
	Average, Cupertino		**25.34**	**26.12**	**.65**	**.35**	**12.91**	**.48**	**2.30**
	Average, Mission San Jose		**27.78**		**.47**				
	Average, Amador station		**27.58**		**.45**				
	Average, Paso Robles		**27.55**		**.40**				
	Malmsey.								
275	Natoma	1884	17.91		.56		9.91	.54	1.60
1698	Tulare	1892	22.40		.47				
1901	Tulare	1893	20.60		.45	.38			
2286	Tulare	1894	23.15	21.80	.34				
1959	Paso Robles	1893	25.90		.33				
	Average, Tulare		**22.05**	**21.80**	**.42**				

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*Fortified.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF SHERRY AND MADEIRA TYPE—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.		
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Total Acid as Tartaric, at 6 to 8 Months	Body
	West's White Prolific.								
500	Cupertino	1886	20.00	18.89	1.00	.26	9.36	.77	2.35
505	Cupertino	1886	19.80	------	.91	------	9.65	.69	2.05
695	Cupertino. (Long-pruned)	1887	23.69	24.01	.78	.27	11.27	.54	2.60
749	Cupertino. (Short-pruned)	1887	26.16	25.19	.66	.44	12.82	.48	2.60
942	Cupertino. (Short-pruned)	1888	25.95	26.99	.48	.37	12.80	.46	
943	Cupertino. (Long-pruned)	1888	25.02	25.76	.60	.28			------
1154	Cupertino	1889	25.90	------	.65	------	------	------	------
1271	Cupertino	1890	20.60	------	.86	.31	------	------	------
2034	Cupertino	1893	21.50	------	.92	------	------	------	------
1045	Fresno	1889	28.30	28.07	.43	.49	------	------	------
1238	Fresno	1890	25.20	25.76	.57	.31	------	------	------
1465	Fresno	1891	25.65	------	.56	------	*18.78	.33	2.85
1531	Paso Robles	1891	24.60	------	.54	------	------	------	------
1754	Paso Robles	1892	24.10	------	.57	------	------	------	------
2069	Paso Robles	1893	25.45	24.64	.58	.32	*19.35	.47	2.85
1640	Tulare	1892	24.35	23.23	.62	.50	*18.25	.52	2.70
1903	Tulare	1893	22.40	20.99	.77	.47	*10.83	.44	2.60
2221	Tulare	1894	24.80	22.67	.76	------	------	------	------
1872	Amador station	1893	22.20	------	1.03	------	------	------	------
2186	Amador station	1894	25.90	------	.70	------	------	------	------
2222	Amador station	1894	27.60	------	.53	------	------	------	------
	Average, Cupertino	------	**25.34**	**25.49**	**.63**	**.34**	**12.29**	**.49**	**2.60**
	Average, Fresno	------	**26.38**	**26.92**	**.52**	**.40**	------	------	------
	Average, Paso Robles	------	**24.72**	**24.64**	**.56**	**.32**	------	------	------
	Average, Tulare	------	**23.85**	**22.29**	**.72**	**.48**	------	------	------
	Average, Amador station	------	**26.75**	------	**.62**	------	------	------	------
	Feher Szagos.								
24	Fresno	1881	17.15	19.54	.32	------	8.22	.56	1.68
25	Fresno	1881	17.15	19.54	.32	------	10.20	.53	1.99
789	Fresno	1887	26.81	26.99	.17	.68	*9.73	.77	------
1213	Fresno	1890	22.40	21.97	.40	.40	------	------	------
1503	Fresno	1891	23.70	23.62	.32	------	*19.08	.39	2.38
	Average, Fresno	------	**21.44**	**22.33**	**.31**	**.54**	**9.21**	**.55**	**1.88**
	Muscatel.								
1024	Fresno	------	25.00	25.19	.42	.47	------	------	------
1215	Fresno	1889	23.30	23.13	.41	.34	------	------	------
1963	Paso Robles	1890	29.65	------	.34	------	------	------	------
1998	Tulare	1893	26.95	------	.47	------	------	------	------
	Average, Fresno	1893	**24.15**	**24.16**	**.41**	**.40**	------	------	------
	Malvasia bianca.								
1360	Cupertino	------	26.10	------	.65	------	------	------	------
2105	Cupertino	------	25.90	------	.74	------	------	------	------
1532	Paso Robles	1890	26.95	------	.31	------	------	------	------
1756	Paso Robles	1893	26.50	------	.24	------	------	------	------
	Average, Cupertino	1891	**26.00**	------	**.69**	------	------	------	------
	Average, Paso Robles	1892	**26.72**	------	**.28**	------	------	------	------

*Fortified.

C. RAISIN AND TABLE GRAPES.

The table-grapes included in this group are, for the most part, well known in California already. Some, such as the Pizzutello and Gros Colman, are worthy of being better known, for they are very showy and attractive, though unfitted for distant shipments, on account of their delicate skin. With different methods of packing and more careful handling, they could be made very profitable for local markets. The grape of Almeria has doubtless a future, for, as the experiments show, it is possible in some localities, by appropriate methods of pruning and training, to make it produce good crops, and it has probably no superior as a keeping grape.

Some of the Spanish Sherry grapes, such as the Mantuo, Beba, Perruno, and Mourisco, are very promising as table-grapes, and are also worthy of trial for the production of raisins. In southern Spain and Portugal very good lye-dipped raisins are made from these varieties, and their heavy bearing and freedom from coulure recommend them in spite of the superior quality of the Muscat of Alexandria. The raisin-grapes are considered in this report principally from the side of their utility as wine producers, though the analyses throw some light on their relative values for drying purposes.

RAISIN-GRAPES.

MUSCAT OF ALEXANDRIA.

(See Vit. Rept. 1885–86, p. 108.)

Description.—Vine small and not very vigorous, spreading in habit; canes short-jointed and of medium size; leaves medium size, round, generally five-lobed, the upper sinuses well marked and closed, the lower shallow and sometimes wanting, the petiolar sinus open, glabrous on both sides, and sharply toothed ; bunches large, winged, loose, sometimes branching; berries large, varying from nearly round to elliptical or obovoid, with thin but rather tough skin, firm, crisp flesh, and green to dull yellow color.

The synonymy of the Muscat is in a somewhat unsettled state. There is no doubt that there exist several forms in California which, by many observers, are classed together as Muscat of Alexandria. Whether these are simple variations due to climatic conditions and selection is impossible at present to say. The Gordo Blanco, which is held by many careful observers to be sufficiently distinct from the Muscat of Alexandria, is chiefly distinguished by the roundness of its berries. This seems hardly sufficient to base a variety on, in view of the fact that both obovoid and nearly round berries are found on the same bunch. The Huasco, which resembles the Gordo Blanco form in roundness of berries and the greater compactness of its bunches, seems also to differ in the greater prevalence of three-lobed leaves. The presence of three or five lobed leaves is, however, a variable characteristic in the Muscat. Nearly all varieties which, like the Muscat, are of ancient origin and wide distribution, exhibit similar variations, due generally to careful selection of cuttings.. Whether or not these various forms are to be considered as true varieties, they are economically of great importance, as by proper selection the quality of the raisins of California can be improved, and the unfortunate liability of the Muscat to coulure may be overcome. At the Experiment Stations the Huasco form has shown considerable superiority in the matter of freedom from coulure; but its round berries and more compact bunches render it somewhat less adapted to the production of "gilt edge" bunch raisins.

As a wine-grape the Muscat of Alexandria is little used, except to make a little sweet " Muscat wine," and occasionally in small quantities, to add aroma to neutral grapes. For the production of sweet Muscat wine it is much inferior to the small Muscatel or Frontignan, and for blending with other varieties it would be well replaced by that grape, by the Malmsey, or by some of the true Malvoisies, whose flavor is more delicate and more suitable to wine-making.

Analyses of Musts and Wines.

MUSCAT OF ALEXANDRIA.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six to Eight Months.	Body	Ash	Sugar
1890—No. 1288.* Cupertino	Oct. 1	20.40	......	.47	.14	......	......	......	......	......	......
No. 1345.* Mission San José	Oct. 11	25.63	......	.51	.21	15.42†	18.98	.41	2.43	......	4.27
No. 1407.* Cupertino	Oct. 21	24.25	......	.58	......	......	......	......	......	......	......
1891—No. 1456.* Fresno	Aug. 28	25.85	25.30	.41	......	14.50†	17.90	.13	2.45	......	......
No. 1535.* Paso Robles	Oct. 3	24.90	......	.40	......	......	......	......	......	......	......
1892—No. 1696. Tulare	Sept. 27	26.00	......	.46	......	......	......	......	......	......	......
No. 1718. Tulare	Oct. 3	25.90	......	.24	......	......	......	......	......	......	......
No. 1719.* Tulare	Oct. 3	24.80	......	.33	......	......	......	......	......	......	......
No. 1731. Paso Robles	Oct. 11	25.65	......	.36	......	......	......	......	......	......	......
No. 1758.* Paso Robles	Oct. 11	24.25	......	.33	......	......	......	......	......	......	......
1893—No. 1972. Tulare	Oct. 14	24.80	24.43	.48	......	......	......	......	......	......	......
No. 1974.* Tulare	Oct. 14	21.40	20.60	.39	.23	......	......	......	......	......	......
1894—No. 2239.* Mission San José	Oct. 5	21.10	......	.50	......	......	......	......	......	......	......

* Huasco. † Fortified.

Record of Treatment.

No. 1288. *Huasco*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 3, 1890, in good condition, but not quite ripe. The bunches and berries were very large, and apparently the same as the spherical form of the Muscat of Alexandria. The must showed 20.4% of solid contents by spindle and 0.47% of acid.

No. 1345. *Huasco*, from Mission San José. Received October 14, 1890, in fair condition. The bunches were long and loose, but with a little coulure; the berries very large and fine. The must showed 25.63% of solid contents by spindle and 0.51% of acid. The temperature of the grapes at crushing was 69°, and the maximum was 76°, reached on the third day. On the fifth day, while the wine was still a little sweet, it was fortified.

At three months the wine was bright, of medium acid and sweetness, and strong Muscat aroma. At this date it was racked and put in the heating-chamber, at a temperature of 110°, for three months. At eight months it was bright, clean-tasting, and well developed. At this time it was racked for the third time. At sixteen months it was in good order, of strong and pleasing aroma, maturing well, and generally improved, but rather too sweet. It gradually improved, and at four years was a bright, clean-tasting, agreeable Muscat. At this date it was put in glass.

No. 1407. *Huasco*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 24, 1890, in good condition, and mature. The bunches were fairly well filled and the berries large. The must showed 24.25% of solid contents by spindle and 0.58% of acid.

No. 1456. *Huasco*, from Fresno. Received August 31, 1891, in good condition, and mature. The must showed 25.85% of solid contents by spindle and 0.41% of acid. The temperature of the grapes at crushing was 76°. The day after crushing the temperature had fallen to that of the room (73°), and reached its maximum of 77° on the third day. The must fermented slowly, and on the seventh day it was fortified while still sweet.

At four months the wine was bright, clean-tasting, and with delicate Muscat aroma and moderate sweetness. Two months later it was racked for the second time, and put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months it was in good order, smooth and agreeable, but in too small a quantity to show its best qualities. Four months later it had improved, and was put in glass.

No. 1535. *Huasco*, from Paso Robles station. A sample for must analysis was received October 5, 1891, in good condition. The bunches were loose and of medium size; the berries were not very large and rather too ripe. The must showed 24.9% of solid contents by spindle and 0.40% of acid.

No. 1696. *Muscat of Alexandria*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 26.0% of solid contents by spindle and 0.46% of acid.

No. 1718. *Muscat of Alexandria*, from Tulare station. A sample for must analysis was received October 5, 1892, in good condition. The must showed 25.9% of solid contents by spindle and 0.24% of acid.

No. 1719. *Huasco*, from Tulare station. A sample for must analysis was received October 5, 1892, in good condition. The must showed 24.8% of solid contents by spindle and 0.33% of acid.

No. 1731. *Muscat of Alexandria*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 25.65% of solid contents by spindle and 0.36% of acid.

No. 1758. *Huasco*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 24.25% of solid contents by spindle and 0.33% of acid.

No. 1972. *Muscat of Alexandria*, from Tulare station. A sample for must analysis was received October 16, 1893, in good condition. The bunches were of medium size, loose, and irregular; the berries large. The must showed 24.8% of solid contents by spindle and 0.48% of acid.

No. 1974. *Huasco*, from Tulare station. A sample for must analysis was received October 16, 1893, in good condition. The grapes were larger than those of No. 1972, and the bunches showed less coulure. The must showed 21.4% of solid contents by spindle and 0.39% of acid.

THOMPSON'S SEEDLESS.

Synonyms: Sultanina; Sultanieh; Sultani.

Description.—Vine very vigorous, and with large trunk and very long canes; leaves glabrous on both sides, dark yellowish-green above and lighter below, generally three-lobed, with shallow sinuses, teeth short and obtuse; bunch large, conico-cylindrical, well filled, on herbaceous peduncles; berries under medium, ellipsoidal, crisp, of neutral flavor, with moderately thick skin of a fine golden-yellow color.

This variety, which was distributed by Elwanger & Barry, New York, in 1872, as a Turkish variety under the name of Lady Decoverly, received the name it is most commonly known under from Mr. Thompson, of Yuba City, who first distributed it in California.

Judging from the complete description of the Sultanina given by J. M. Guillon (Revue de Viticulture, tome 3, p. 216, 1895) there can be little doubt that our California Thompson's Seedless is identical with it. It is from this grape that the Sultana grapes of Asia Minor are made. It is also grown to some extent in Greece for the same purpose. It bears plentifully, even with short-pruning, though in its native land it is pruned long.

The Sultanina is supposed by some authorities to be a simple cultural variation of the Sultana, but this is extremely improbable, for its distinctly elongated berries denote, in the absence of any intermediate forms, a different origin from the perfectly round berries of the Sultana.

ANALYSES OF MUSTS.

THOMPSON'S SEEDLESS.	Date of Picking...	Solid Contents by spindle........	Acid as Tartaric...	Ash...........
1890—No. 1376. Cupertino	Oct. 15	26.92	.45	......
1892—No. 1636. Tulare	Sept. 4	24.45	.33	......
1893—No. 1894. Tulare	Sept. 23	25.05	.37	.31

RECORD OF TREATMENT.

No. 1376. *Thompson's Seedless*, from Cupertino. A sample for must analysis was received October 17, 1890, in good condition. The bunches were irregular, winged, and loose, on slender, green peduncles; the berries oblong, of light golden color, on long pedicels; the skin was thick but tender, the flesh crisp, sweet, and agreeable. The must showed 26.92% of solid contents by spindle and 0.45% of acid.

No. 1636. *Thompson's Seedless*, from Tulare station. A sample for must analysis was received September 6, 1892, in good condition. The must showed 24.45% of solid contents by spindle and 0.33% of acid.

No. 1894. *Thompson's Seedless*, from Tulare station. A sample for must analysis was received September 25, 1893, in good condition. The bunches were of medium size, well filled, but not compressed; the berries under medium size, very irregular in shape, from nearly spherical to long ellipsoidal; peduncles and pedicels slender; flesh crisp and very sweet; color golden-yellow, with light bloom. The must showed 25.05% of solid contents by spindle and 0.37% of acid.

SULTANA.

(See Vit. Rept. 1885-86, p. 102.)

Synonym: Seedless Sultana.

Description.—Vine vigorous, upright; leaves large, five-lobed, with rather shallow sinuses, light colored, and coarsely toothed; bunches large, long-cylindrical, with heavy shoulders or wings, well filled when not coulured, but not compacted; berries small, round, firm and crisp, golden-yellow, and without seeds.

The Sultana is widely cultivated in California as a raisin and table grape, though for the latter purpose it is being partially superseded by Thompson's Seedless. It does not correspond to any available description of European or Asiatic grapes. The Sultanina, from which the bulk of the seedless raisins of Smyrna is made, resembles much more closely the Thompson's Seedless than our California Seedless Sultana. As a raisin-grape the Sultana is too well known to need any description. It is for raisins, rather than for wine-making, that it will be found useful. Its wine is neutral and fairly agreeable, but never attains high quality and is not a very good keeper. Blended with other grapes it may be used in the production of sweet wines, but, in the coast counties especially, its acid is rather too high for this purpose. It is to this acidity that the superior piquancy which is claimed for its raisins over those of the Thompson's Seedless is doubtless due. The identity of this grape has not yet been established. It is probably the round-berry Kechmish to which Odart refers, and which he says enters into the composition of the wines of Schiraz.

Analyses of Musts and Wines.

SULTANA.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six Months	Volatile Acid at Six Months	Body
1887—No. 774. Cupertino	Oct. 24	26.10	26.31	.41	.34	10.81	13.27	.47	.06	2.30
1888—No. 892. Cupertino	Oct. 8	22.97	23.13	.49	.27	10.63	13.09	.48	----	2.70
No. 893. Cupertino	Oct. 8	26.51	27.65	.39	.29					
1890—No. 1356. Mission San José	Oct. 13	26.60	------	.54	----	--------	------	------	----	----
1891—No. 1483. Fresno	Sept. 9	22.11	21.22	.60	----	*15.50	19.08	.44	----	3.30
1892—No. 1711. Mission San José	Oct. 4	25.00	25.19	.62	.25	9.56	11.91	.61	----	2.70
No. 1715. Tulare	Oct. 3	21.20	------	.30	----	--------	------	------	----	----
1893—No. 2066. Mission San José	Nov. 1	27.15	------	.60	----	--------	------	------	----	----
1894—No. 2245. Mission San José	Oct. 3	26.00	------	.56	----	--------	------	------	----	----

*Fortified.

Record of Treatment.

No. 774. *Seedless Sultana*, from J. T. Doyle, Cupertino. Received October 25, 1887, in good condition. The bunches and berries were very uneven in size, and showed some coulure. Part of the grapes were from long-pruned and part from short-pruned vines. Those from long-pruned vines were the finest and showed the least coulure. The must showed 26.1% of solid contents by spindle and 0.41% of acid. The temperature of the grapes at crushing was 74°, and the maximum reached was 84°, on the second day. The fermentation was over on the eleventh day, when the wine was racked off.

At one month the wine was racked and taken to the cellar. A month later it was clear, sound, with low, pleasant acid, but little character. At four months it was racked for the third time, and at seven months it was bright, pleasant, and sound. At this date a microscopical examination of the lees showed no unsound ferments, and the wine was racked into glass. A month later the wine was in good condition and had developed a little bouquet.

Nos. 892 and 893. *Seedless Sultana*, from J. T. Doyle, Cupertino. Received October 9, 1888, in good condition. The numbers refer to samples from long-pruned and from short-pruned vines, respectively. Both samples showed a good deal of coulure, but the long-pruned was the most evenly ripened, though somewhat sunburned. The must showed 22.97% of solid contents by spindle and 0.49% of acid for the short-pruned, and

26.51% of solid contents by spindle and 0.39% of acid for the long-pruned. The must from both samples was fermented in one cask.

At seventeen days the wine was drawn off, and at one month it was racked and taken to the cellar. At three months it was clear, of good flavor, pleasant acid, and adequate alcohol. At five months it was racked again, and the lees examined and found to be sound. Tastings at ten and at fourteen months showed improvement and the development of some bouquet. At sixteen months it was bright and of good bouquet, but the after-taste was not quite clean. At this time the wine was racked and part put in bottle. At twenty-one months the lees were sound and the wine was bright, improved generally, clean-tasting, and with good flavor. A month later it was bottled. At twenty-eight months the wine bottled at sixteen months was clear, but had made some deposit in the bottle; that bottled at twenty-two months was bright, without deposit, and of good quality. At four years both wines were very good, but the second bottling was fresher-tasting and had a more pronounced bouquet.

No. 1356. *Sultana*, from Mission San José. A sample for must analysis was received October 14, 1890, in good condition. The bunches were large, winged, with medium-sized berries. The must showed 26.6% of solid contents by spindle and 0.54% of acid.

No. 1483. *Sultana*, from Egger's Vineyard, Fresno. Received September 11, 1891, in good condition. The must showed 22.11% of solid contents by spindle and 0.60% of acid. The temperature of the grapes at crushing was 70°, and the maximum, reached the sixth day, was 73°. The fermentation was very slow, and on the eleventh day the wine was fortified.

At four months the wine was bright, mild, and clean-tasting, of medium sweetness, and almost colorless. A month later it was racked for the second time, and at six months put in the heating-chamber, at a temperature of from 90° to 95°, for three months. At two years and ten months the wine was bright and in good order, but lacking in flavor, and vapid, without any real Sherry flavor. Four months later it had improved a little, but lacked character. It was put in glass, on account of the smallness of the quantity.

No. 1711. *Sultana*, from Mission San José. Received October 5, 1892, in fair condition. The must showed 25% of solid contents by spindle and 0.62% of acid. The temperature of the grapes at crushing was 69°, and the maximum, reached the third day, was 80°. On the eighth day the wine was dry, and was racked off.

At one month the wine was cloudy, but was quite dry. It was racked for the second time, and at three months it was bright, with little aroma, but pleasant flavor, medium acid, full body, and clean taste. At five months, when it was racked again, it was in good condition and had improved. At eight months it was in good order, but had not developed any bouquet. At ten months it showed a little bouquet. At fourteen months it was very good, and had kept remarkably well, considering the smallness of the quantity. A month later it was bottled.

No. 1715. *Sultana*, from Tulare. A sample for must analysis was received October 5, 1892, in good condition. The must showed 21.2% of solid contents by spindle and 0.30% of acid.

No. 2066. *Sultana*, from Mission San José. A sample for must analysis was received November 1, 1893, in good condition. The bunches were large, irregularly branching, and well filled; the berries from small to medium, and very sweet. The must showed 27.15% of solid contents by spindle and 0.60% of acid.

BLACK TABLE-GRAPES.

BLACK HAMBURG AND BLACK PRINCE.

(See Vit. Rept. 1885-86, p. 76.)

Synonyms: Trollinger; Frankenthaler.

Description.—Vine very vigorous, with thick, light-colored canes; leaves large, wider than long, not deeply cut, glabrous above and nearly so below, except for a considerable hairiness on the nerves; bunches large, short, winged, rather loose, on long peduncles; berries large to very large, generally round, and on long pedicels; flesh firm, crisp, juicy, and with little flavor, but agreeable to eat.

The Black Hamburg takes the place among red grapes occupied by Chasselas among the white. Its regularity of bearing, the ease with which it is cultivated, and the wide range of conditions under which it thrives as a table-grape, have caused it to be planted in small quantities over almost the whole of the vine-growing world. This wide distribution has led to the production of innumerable variations of the grape, and to a large and confusing synonymy. The Black Prince, which is now extensively cultivated in California as a table-grape for the home market, seems to be only one of the numerous variations of the Black Hamburg, valuable for its large bunches of fine, crisp, but rather flavorless berries. The few wines made from it show it to be little better for this purpose in California than the Black Hamburg. It attains, apparently, a higher percentage of sugar, but makes an equally characterless, vapid wine, of poor keeping qualities.

ANALYSES OF MUSTS AND WINES.

BLACK PRINCE.	Date of Picking	MUST.				WINE.					
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol.		Tannin	Total Acid as Tartaric.		Body
						By Weight	By Volume		At Pressing	At Six Months	
1887—No. 781. Cupertino	------	24.70	24.64	.53	.44	10.35	12.82	.240	.45	.45	3.10
1890—No. 1265.* Cupertino	Sept. 28	15.87	------	.54	------	------	------	------	------	------	------
1892—No. 1699. Tulare	Sept. 28	24.10	------	.33	------	------	------	------	------	------	------
1893—No. 1956. Paso Robles	Oct. 13	25.20	24.12	.42	.38	9.49	11.82	.102	.42	.46	2.80
No. 2003. Tulare	Oct. 21	23.70	22.40	.32	.50	8.62	10.75	.071	.33	.43	2.50
1894—No. 2347. Tulare	Oct. 27	23.70	------	.18	------	------	------	------	------	------	------

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* Black Hamburg.

RECORD OF TREATMENT.

No. 781. *Black Prince*, from J. T. Doyle, Cupertino. Received October 26, 1887, in good condition. The stems were green, but the grapes were fully ripe and a few were overripe. The berries were slightly oval, very large, soft, juicy, and thin-skinned. The must showed 24.7% of solid contents by spindle and 0.53% of acid. The grapes were crushed after arrival at a temperature of 70°. The maximum temperature, reached the third day, was 83°. The fermentation was very violent, and was finished on the fifth day.

At two months the wine was very pleasant, clean-tasting, and light-bodied. At four months it was racked for the second time; it was bright, clean-tasting, but thin and without special flavor. For three or four months it remained bright and of fair quality, but later it deteriorated and did not keep well.

No. 1699. *Black Prince*, from Tulare station. A sample for must analysis was received September 29, 1892, in good condition. The must showed 24.1% of solid contents by spindle and 0.33% of acid.

No. 1956. *Black Prince*, from Paso Robles station. Received October 15, 1893, in fair condition. The bunches were large and irregular, loose; the berries on some bunches were large, well formed, and well colored, on others abortive and dried up. The must showed 25.2% of solid contents by spindle and 0.42% of acid. The grapes at crushing showed 64°, and the maximum temperature, reached the third day, was 81°. On the fourth day the wine was dry, and on the fifth day it was drawn off.

At one month the wine was racked for the second time and taken to the cellar; it was almost clear, but contained a little sugar and was almost without color. At three months it was clear, but thin, flat, and of very poor quality. A month later it was racked again, but did not improve.

No. 2003. *Black Prince*, from Tulare station. Received October 23, 1893, in good condition. The bunches were large, conical, shouldered, well filled, but not compact; the berries large, oval, light colored, and very sweet. Some second-crop bunches mixed with the others were smaller, and had smaller and more deeply colored berries, which were less ripe than the first crop. The must showed 23.7% of solid contents by spindle and 0.32% of acid. The temperature of the grapes at crushing was 67°. The must fermented slowly, and was still a little sweet when drawn off on the fourth day. The wine was of poor quality, and soon deteriorated. At three months it was clear, but flat and worthless. It did not improve, and at six months was thrown away.

GROS COLMAN.

Synonyms: Dodrelabi; Ochsenauge; Eichkugeltraube.

Description.—Vine strong-growing, with dark brownish wood; leaves very large, round, thick, very slightly lobed, shortly and bluntly toothed, glabrous above, close-woolly below; bunches large, short, well filled, but not compact; berries very large, round, dark blue, with thick but tender skin.

The Dodrelabi is remarkable, as having the largest berries of any round-berry variety known. It is cultivated largely in eastern and central Europe, and is also a very great favorite in the hothouses of England and Belgium. It is probably the handsomest black table-grape grown; its large, round berries, which are not pressed out of shape by too great compactness of the bunches, are very attractive in appearance and very agreeable too eat. The grapes have good keeping qualities, except that they are very liable to crack. They are, on this account, difficult to ship to any great distance.

ANALYSES OF MUSTS.

GROS COLMAN.		Date of Picking	Solid Contents by Spindle	Acid as Tartaric	Ash
1890—No. 1269.	Cupertino	Oct. 1	14.70	.57	......
No. 1425.	Mission San José	Oct. 29	21.95	.42	......
1893—No. 1932.	Paso Robles	Oct. 11	15.20	.40	.33
No. 1973.	Tulare	Oct. 14	21.50	.41	.33

RECORD OF TREATMENT.

No. 1269. *Gros Colman*, from Cupertino. A sample for must analysis was received October 2, 1890, in fair condition, some of the berries being cracked and not quite ripe. The must showed 14.7% of solid contents by spindle and 0.57% of acid.

No. 1425. *Gros Colman*, from Mission San José. A sample for must analysis was received October 31, 1890, in poor condition. The grapes were mature and very fine-looking, but crushed and moldy. The must showed 21.95% of solid contents by spindle and 0.42% of acid.

No. 1932. *Gros Colman*, from Paso Robles. A sample for must analysis was received October 13, 1893, in fair condition. The grapes were very irregular in size and coloring; some bunches were well filled with large, well-colored berries, others were loose, with small, greenish, flavorless berries. The must showed 15.2% of solid contents by spindle and 0.40% of acid.

No. 1973. *Gros Colman*, from Tulare. A sample for must analysis was received October 16, 1893, in good condition. The bunches were of medium size, cylindrical, close; the berries very large, crisp, juicy, and tender-skinned, with little flavor and not very sweet, though some berries were commencing to dry up. The must showed 21.5% of solid contents by spindle and 0.41% of acid.

BLACK MOROCCO.

Description.—Vine a strong grower, with thin, spreading canes; leaves under medium size, very deeply five-lobed, even when very young, the younger leaves truncate at base, giving them a semi-circular outline, with long, sharp teeth alternating with very small ones, glabrous on both sides; bunches very large, short, shouldered, and compact; berries very large, round, often angular from compression, fleshy, of neutral flavor, dull purple color or colorless in the center of the bunch. This grape is remarkable for the number of second-crop bunches which it produces on the laterals.

The Black Morocco is late in ripening and of very fine appearance, a fairly good shipping-grape, but difficult to pack on account of the size and rigidity of the bunches. The grapes are of an agreeable crispness, but lacking in flavor.

RECORD OF TREATMENT.

No. 1351. *Black Morocco*, from Cupertino. A sample for must analysis was received October 13, 1890, in good condition, and mature. The must showed 16.7% of solid contents by spindle and 0.65% of acid.

No. 2024. *Black Morocco*, from Tulare station. A sample for must analysis was received October 26, 1893, in good condition. The bunches were of medium size, short cylindrical, and compact; the berries very large and fairly well colored. The must showed 20.2% of solid contents by spindle and 0.45% of acid.

CALIFORNIA BLACK MALVOISIE.

(See Vit. Rept. 1887–89, p. 212.)

This variety, which has been afflicted with more inappropriate and misleading synonyms than fall to the lot of most grapes, even in California, resembles the Cinsaut in its berries and in the form of its leaves; but the bunches are much more loose and lack the peculiar aroma of the Cinsaut, and the leaves are much larger and the vine of stronger and longer growth. Its wine matures quickly, and is pleasant to the taste at six to eight months, but does not improve with age, and is a poor keeper. It is certainly utterly different from any variety of the Malvoisie type, but the name given above has become so closely identified with it that it is perhaps best to retain it. This variety has been generally abandoned, except as a table-grape for local markets.

Analyses of Musts.

CALIFORNIA BLACK MALVOISIE.	Date of Picking	MUST.	
		Solid Contents by Spindle	Acid as Tartaric
1891—No. 1478. Paso Robles	Sept. 1	22.80	.55
1893—No. 1855. Amador station	Sept. 12	20.20	.60
1894—No. 2194. Amador station	Sept. 25	23.40	.59
No. 2224. Amador station	Oct. 3	27.60	.43

Record of Treatment.

No. 1478. *California Malvoisie*, from Paso Robles station. A sample for must analysis was received September 3, 1891, in good condition, and riper than the Cinsaut from the same place. The must showed 22.8% of solid contents by spindle and 0.55% of acid.

No. 1855. *California Malvoisie*, from Amador station. A sample for must analysis was received September 15, 1893, in good condition. The bunches were of good size, well filled, but not compact; the berries large and not quite mature; there was no sign of coulure. The must showed 20.2% of solid contents by spindle and 0.60% of acid.

CORNICHON.

Synonyms: Cornichon Violet; Eicheltraube.

Description.—Vine a heavy grower, with thick, light brown, short-jointed wood; leaves large, longer than wide, deeply five-lobed, dark green above, and lighter and very hairy below, coarsely toothed, and with short, thick petiole; bunches very large, loose, on long peduncles; berries large, long, more or less curved, darkly colored and spotted, thick-skinned, and on long pedicels.

This variety has been grown as a table-grape with great success in California, and is desirable on account of its attractive appearance, curious shape, excellent shipping qualities, and late ripening. On account of the length of its stalks and the looseness of its bunches, it is very easy to pack, even when the bunches are very large. The grapes grown at

Tulare under this name seem to differ considerably from the typical Cornichon as it is found in the more northern counties. It has more symmetrical berries and lighter color.

Record of Treatment.

No. 1350. *Purple Cornichon*, from Cupertino. Received October 13, 1890, in good condition. A sample for must analysis was all that was received. The grapes were mature, and showed 17.2% of solid contents by spindle and 0.68% of acid.

No. 2007. *Purple Cornichon*, from Tulare station. A sample for must analysis was received October 23, 1893, in good condition. The bunches were small, irregular, loose; the berries large, long-elliptical, symmetrical, varying in color from brownish-pink to purple, fleshy, and thick-skinned. The must showed 19.3% of solid contents by spindle and 0.50% of acid.

EMPEROR.

Description.—Vine a strong, vigorous grower; leaves very large, with five shallow lobes, short, obtuse teeth, glabrous above, woolly beneath, light green in color; bunches very large, long, conical, loose, with large, dull purple, oval, firm berries.

This is an excellent shipping-grape of fine appearance, but of little flavor, and thick-skinned. When grown in a suitable location, and when properly trained, it is an immense bearer, and very satisfactory as a late shipping-grape. The vine must be allowed to extend itself; the vine and its arms should reach for seven or eight feet at least and should be short-pruned. When it is cut back to a mere stump the grapes do not set well.

Record of Treatment.

No. 1349. *Emperor*, from Cupertino. A sample for must analysis was received October 13, 1890, in good condition, and mature. The must showed 19.3% of solid contents by spindle and 0.66% of acid.

No. 2236. *Emperor*, from Mission San José. A sample for must analysis was received October 4, 1894, in good condition. The bunches were large, loose, with little coulure; berries large, hard, and without flavor. The must showed 15.4% of solid contents by spindle and 0.72% of acid.

RED TABLE-GRAPES.

BARBAROSSA.

Synonyms: Barbarossa del Piedmonte; Uva Regina.

Description.—Vine prolific and of medium vigor; leaves small, deeply five-lobed, with closed sinuses, glabrous on both sides except for some short, stiff hairs on the under side; bunches large, very much winged, well filled; berries over medium size, round, crisp, juicy, and of agreeable but neutral flavor, skin tender and of a bright rose color.

This variety is cultivated to a large extent in Piedmont as a late table-grape, and to a less extent as a wine-grape. There are several distinct varieties, which go under the name of Barbarossa in Italy, but the one described above, which is the one at the Experiment Stations, is the most esteemed. At Mission San José and at Cupertino it has shown itself a fair bearer and a very agreeable and showy table-grape. It is, however, too delicate for general shipping purposes in California. At Tulare it has borne well, but failed to color. As a wine-grape the results have not been promising. Alone, it makes a thin, neutral wine. However, as it attains uniformly a good percentage of sugar with adequate acid, it might be used as a blend with a variety of more character. It can at present be recommended only as a showy table-grape for home use and for keeping during the winter months. The vine bears well with short-pruning, and requires a fairly rich soil in a warm, dry location. On irrigated or over-rich soils it fails to color.

ANALYSES OF MUSTS AND WINES.

BARBAROSSA.	Date of Picking	MUST.				WINE.				
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six Months	Volatile Acid, at Six Months	Body
1887—No. 746. Cupertino	Oct. 16	24.60	23.61	.47	.42	10.16	12.64	.52	.07	2.60
1890—No. 1266. Cupertino	Sept. 29	22.90	------	.58	.27	------	------	------	----	------
No. 1429. Mission San José	Oct. 28	28.50	------	.44	---	------	------	------	----	------
1892—No. 1740. Paso Robles	Oct. 10	24.80	------	.37	---	------	------	------	----	------
No. 1775. Mission San José	Oct. 13	22.85	23.13	.59	----	9.34	11.64	.65	----	2.44
1893—No. 1980. Tulare	Oct. 17	21.50	20.69	.47	.30	8.20	10.25	.45	----	2.80
No. 1995. Mission San José	Oct. 19	24.80	------	.52	---	------	------	------	----	------
No. 2088. Cupertino	Nov. 4	24.80	------	.77	---	------	------	------	----	------
1894—No. 2230. Mission San José	Oct. 3	22.80	------	.48	---	------	------	------	----	------

RECORD OF TREATMENT.

No. 746. *Barbarossa*, from J. T. Doyle, Cupertino. Received October 18, 1887, in excellent condition. The bunches were very large and short; the berries very large, sweet, and with little acid or flavor. The must showed 24.6% of solid contents by spindle and 0.47% of acid. The temperature of the grapes at crushing was 80°, and the maximum, reached the following day, was 86°. The wine was drawn off the thick lees on the tenth day.

At two months the wine was bright, of fair aroma, adequate and pleasant acid, good body—a sound but neutral wine. A month later it was racked again and pasteurized for safety. At eight months it was bright, but quite neutral and somewhat flat.

No. 1266. *Barbarossa*, from J. T. Doyle, Cupertino. A sample for must analysis was received October 2, 1890, in good condition, and mature. The bunches were large, pyramidal, and close; the berries varying from large to very small; skin thick but tender; color light garnet, except those in the middle of the bunch, which were green; pulp crisp, juicy, sweet, with neutral flavor; peduncles thick and strong. The must showed 22.9% of solid contents by spindle and 0.58% of acid.

No. 1429. *Barbarossa*, from Mission San José. A sample for must analysis was received October 30, 1890, in fair condition, and mature. The must showed 28.5% of solid contents by spindle and 0.44% of acid.

No. 1740. *Barbarossa*, from Paso Robles station. A sample for must analysis was received October 13, 1892, in good condition. The must showed 24.8% of solid contents by spindle and 0.37% of acid.

No. 1775. *Barbarossa*, from Mission San José. Received October 15, 1892, in good condition. The must showed 22.85% of solid contents by spindle and 0.59% of acid. The temperature of the must at crushing was 62°, and the maximum, reached the fourth day, was 80°. On the ninth day the wine was racked off the thick lees.

At one month the wine was quite clear. At this date it was racked for the second time and taken to the cellar. At three months it was bright, without aroma, but with some flavor, of medium acid, and good body; a clean-tasting, neutral wine. Two months later it was racked again; it was in good order and was very pleasing, but of perfectly neutral character. Tastings at eight, ten, and fourteen months showed that the wine remained in good order; it was of pleasing character, but neutral and quite lacking in bouquet. At seventeen months it was bottled.

No. 1980. *Barbarossa*, from Tulare station. Received October 18, 1893, in good condition. The bunches were large to medium, winged, and close; the berries large, round, soft, and juicy, most of them green in color, but some pinkish and the second-crop bunches rose-colored. The must showed 21.5% of solid contents by spindle and 0.47% of acid. The temperature of the grapes at crushing was 63°, and the maximum, reached the third day, was 78°. The wine was dry on the fifth day, when it was racked off.

In three weeks the wine was clear, but rather flat and insipid. A month later it had improved somewhat, but showed little character. At this time it was racked and taken to the cellar. At three months it was clear, a fair, neutral wine, with little flavor or aroma. A month later it was racked again, and at six months it was in good order, sound but somewhat characterless. At ten months it had suffered a little from the smallness of the keg; it was mature, and was bottled.

No. 1995. *Barbarossa*, from Mission San José. A sample for must analysis was received October 19, 1893, in good condition. The bunches were large, conico-cylindrical, winged or shouldered, rather close; the berries a little over medium size, slightly ob-compressed when free, fleshy and fairly resistant, of a deep rose color, sweet and pleasant to eat. The must showed 24.8% of solid contents by spindle and 0.52% of acid.

No. 2088. *Barbarossa*, from J. T. Doyle, Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, irregular, branching, a little coulured; the berries of unequal size, round, crisp, and with full acid. The must showed 24.8% of solid contents by spindle and 0.77% of acid.

FLAME TOKAY.

Synonyms: Flaming Tokay; Uva de Ragol.

Description.—Vine a strong grower; leaves of medium size, light yellowish-green in color, slightly lobed, long-toothed, glabrous on both sides; bunches large, close, conico-cylindrical, on thick peduncles; berries large, longer than wide, flattened at the ends, fleshy, crisp, flesh-colored where exposed to the light, green when too much shaded.

This variety, which has been grown so extensively in California as a shipping-grape, is the "Uva de Ragol" or "Culo de Horza," which is grown largely in Sevilla, and where it is very highly valued as a good-keeping grape, a reputation which it sustains equally in California. It is most successful on a clayey soil; on sandy and alkali soils it bears well, but fails to color its berries well. The vine has been supposed to be able to resist the phylloxera. It resists, however, only in a manner similar to several other European varieties; that is to say, when it is in a particularly favorable soil it will continue to live for many years after its roots are thoroughly invaded by the insect, and after other varieties in the same ground are dead. It is not properly a resistant, for it is so injured and weakened by the attacks of the parasite that it is worthless either for direct bearing or grafting.

RECORD OF TREATMENT.

No. 1928. *Flame Tokay*, from Natoma. A sample for must analysis was received October 12, 1893, in good condition. The must showed 19.5% of solid contents by spindle and 0.36% of acid.

WHITE TABLE-GRAPES.

LUGLIENGA.

Synonyms: Lignanga; Lignan blanc; Gelbe Seidentraube.

The wide range of this grape is indicated by the host of synonyms under which it labors, and of which the above are but a few of the commoner.

Description.—Vine strong-growing, and sensitive to frost; leaves of medium size, deeply five-lobed, dark green, glabrous on both sides, sharply toothed, the terminal tooth of each lobe very long and acuminate; bunches of medium size, well filled; berries of medium size, oval, at first green, becoming yellow with overripeness, with thin skin, crisp, firm flesh, and agreeable flavor.

The Luglienga, the name of which means July grape, is one of the earliest grapes known. This, in connection with its good quality as an eating-grape, and the length of time which it will keep, has made it a favorite grape for home use nearly all over Italy and in many parts of France, Austria, and Germany. It is said that one vine of this variety will often suffice to supply a whole family with grapes from the beginning to the end of the grape season. It is on account of this fact that it is called in Piedmont "Bona in Ca," meaning "good to grow on the house."

The name of "Seidentraube" (silk grape) comes from the peculiar soft feeling which the grape has when being eaten, and which is one of its chief merits. The vine is unsuited to head-pruning, and seldom produces more than half a crop, on account of its liability to coulure unless allowed to extend itself. This grape would be excellent for home markets, and much superior to the early Sweetwaters, which usually appear in the market first. It is rather too thin-skinned for long shipments, but if handled carefully will keep a long time.

RECORD OF TREATMENT.

No. 1210.* *Luglienga*, from Fresno. A sample for must analysis was received August 25, 1890, in fair condition. The grapes were quite ripe, and showed 20.85% of solid contents by spindle and 0.32% of acid.

No. 1214. *Luglienga*, from Fresno. A sample for must analysis was received August 25, 1890, in fair condition. The grapes were overripe, and showed 20.85% of solid contents by spindle and 0.33% of acid.

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*Imported under name of Gelbe Seidentraube.

No. 1305.* *Luglienga*, from Cupertino. A sample for must analysis was received October 8, 1890, in good condition, but overripe and commencing to shrivel. The must showed 24.25% of solid contents by spindle and 0.34% of acid.

No. 1441. *Luglienga*, from Tulare station. A sample for must analysis was received August 29, 1891, in good condition. The must showed 23.7% of solid contents by spindle and 0.36% of acid.

No. 1812. *Luglienga*, from Amador station. A sample for must analysis was received September 1, 1893, in good condition. The must showed 21.1% of solid contents by spindle and 0.47% of acid.

No. 2087. *Luglienga*, from Cupertino. A sample for must analysis was received November 6, 1893, in good condition. The bunches were of medium size, long-conical, winged, well filled; berries under medium size, oval, very sweet, and overripe, but still firm and of very agreeable flavor. The must showed 28.0% of solid contents by spindle and 0.35% of acid.

PIZZUTELLO DI ROMA.

Synonyms: Weisse Eicheltraube; Cornichon blanc; Santa Paula.

Description.—Leaves five-lobed not deeply cut, together with the young shoots glabrous on both sides; bunches large, long, loose; berries long and thin, generally curved, crisp, thin-skinned.

The synonomy given above is perhaps a little doubtful, and may include two varieties similar in fruit but differing in leaf characters. The one described is the favorite table-grape grown in the outskirts of Rome. It is of very attractive appearance and agreeable crispness, but almost totally lacking in flavor. Its remarkably thin and tender skin increases its desirability as an eating-grape, but militates very much against its shipping qualities. It is much inferior in this respect to the Black Cornichon, which it resembles in shape and flavor.

RECORD OF TREATMENT.

No. 2006. *Pizzutello di Roma*, from Tulare. A sample for must analysis was received October 23, 1893, in good condition. The bunches were of medium size, short-cylindrical, loose, on slender peduncles; the berries large, long, generally curved, hard, flavorless, on thick pedicels. The must showed 22.2% of solid contents by spindle and 0.38% of acid.

ALMERIA.

Description.—Vine vigorous; leaves of medium size, round, and slightly or not at all lobed, quite glabrous on both sides, teeth obtuse and alternately large and small; bunches large, loose or compact, irregularly conical; berries from small to large, cylindrical, flattened on the ends, very hard and tasteless.

The grape cultivated at the Experiment Stations under this name is one of the several varieties which are shipped in such large quantities from Malaga and Almeria packed in sand or cork-dust. The chief of these varieties are the De Loxa, Ataubi, and Ciuti, all white grapes of similar character, having the common properties of late ripening, hard, crisp flesh, and firm attachment to the pedicel. Which of these varieties we have under the name of Almeria has not yet been determined. The above description is drawn up from the vines growing at the Tulare station.

The grapes ripen late and attain about 20.0% of sugar. They have remarkable keeping qualities and resist mold, fermentation, and drying-up better than any grape which we have tried. Some berries, detached from the bunch and placed loose in a box, remained perfectly good and with very little shriveling for over four months. The difficulty which has been experienced in causing this variety to bear has been, in the cooler localities, due to the lack of sufficient heat, but in the hot interior valleys to an unsuitable method of pruning. An instance was brought to our notice by Mr. A. D. Shepard, which illustrates this fact. A vineyardist in the San Joaquin Valley, becoming disgusted with a patch of these vines which he had been cultivating for years without obtaining any grapes, allowed the vines to grow without any care, not even pruning them. The next season he obtained a large crop.

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*Imported under name of Gelbe Seidentraube.

At Tulare the vines being allowed to extend themselves have given good crops. The vine should therefore be trained on trellis or wires, allowed to spread over a good deal of ground, and should only be planted in the hotter localities.

RECORD OF TREATMENT.

No. 2023. *Almeria*, from Tulare station. Received October 26, 1893, in good condition. The bunches were large, loose to compact, irregularly conical; berries from small to large, cylindrical, flattened on the ends, very hard and tasteless. The must showed 19.7% of solid contents by spindle and 0.54% of acid.

AMERICAN TYPE.

HERBEMONT.

Description.—Vine a vigorous grower, with slender, short-jointed canes; leaves of medium size, with five strongly marked lobes, yellowish-green and glabrous above, very rough and hairy below; bunches of medium size to large, well shouldered, compact; berries small, round, juicy, with little foxiness.

Analyses of Musts and Wines.

HERBEMONT.	Date of Picking	MUST.			WINE.					
		Solid Contents by Spindle	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Acid at Pressing	Acid at Six Months	Tannin	Body
1890—No. 1386. Cupertino	Oct. 19	22.40	.69	......	......	......	......	......	......	......
1892—No. 1749. Paso Robles	Oct. 11	23.70	.56	......	......	......	......	......	......	......
No. 1767. Mission San José	Oct. 16	21.30	1.05	......	8.48	10.58	.96	.73	.222	2.95
1893—No. 2001. Tulare	Oct. 21	20.20	.76	.37	7.43	9.27	.75	.52	.134	3.00
No. 2125. Cupertino	Nov. 3	24.40	.85	......	......	......	.90	......	.163	......

Record of Treatment.

No. 1386. *Herbemont*, from Cupertino. A sample for must analysis was received October 21, 1890, in good condition, and ripe. The must showed 22.4% of solid contents by spindle and 0.69% of acid.

No. 1749. *Herbemont*, from Paso Robles. A sample for must analysis was received October 13, 1892, in good condition. The grapes were very small, and showed 23.7% of solid contents by spindle and 0.56% of acid.

No. 1767. *Herbemont*, from Mission San José. Received October 18, 1892, in good condition. The must showed 21.3% of solid contents by spindle and 1.05% of acid. The temperature of the grapes at crushing was 58°, and the maximum, reached the fourth day, was 87°. On the fifth day the wine was dry, and was drawn off.

The wine was blended with a small quantity of Petit Bouschet, but unfortunately the record of the exact amount was lost. At two months the wine was clear, dry, and of deep color. At three months it was racked for the second time; it was bright, sound, and with full acid, not delicate, but with little foxiness. Two months later it was equally good; it was a good, sound wine, but not of agreeable aroma. At this date it was racked again. At eight months it showed advanced development and had improved. At fourteen months it had retained its good qualities, but was still rather rough. Four months later it was put in bottle.

No. 2001. *Herbemont*, from Tulare. Received October 23, 1893, in good condition. The bunches were small, irregularly conical, close; the berries small, nearly round, with very little foxiness, not well colored. The must showed 20.2% of solid contents by spindle and 0.76% of acid. The temperature of the grapes at crushing was 68°, and the maximum, reached the third day, was 94°. On the fourth day the wine was dry, and was racked off.

At one month the wine was clear, and was racked off and taken to the cellar. At four months it was racked again; it was clear, very light in color, clean-tasting, and of good acid, but not of good aroma. At this date it was racked for the second time. After this the wine deteriorated, and at ten months was flat and poor; the lees showed unsound germs. At sixteen months it was a flat, tasteless wine, without color or other good quality.

No. 2125. *Herbemont*, from Cupertino. A sample for must analysis was received November 5, 1893, in good condition. The bunches were of medium size, conical, winged, close; the berries under medium size, crisp, somewhat pulpy, sweet, with good acid and little foxiness. The must showed 24.4% of solid contents by spindle and 0.85% of acid.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF RAISIN, TABLE, AND OTHER GRAPES.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	RAISIN GRAPES.										
	Muscat of Alexandria.										
1288	Cupertino	1890	20.40		.47	.14					
1407	Cupertino	1890	24.25		.58						
1345	Mission San José	1890	25.63		.51	.21	*18.98			.41	2.43
2239	Mission San José	1894	21.10		.50						
1456	Fresno	1891	25.85	25.30	.41		17.90			.13	2.45
1535	Paso Robles	1891	24.90		.40						
1731	Paso Robles	1892	25.65		.36						
1758	Paso Robles	1892	24.25		.33						
1696	Tulare	1892	26.00		.46						
1718	Tulare	1892	25.90		.24						
1719	Tulare	1892	24.80		.33						
1972	Tulare	1893	24.80	24.43	.48						
1974	Tulare	1893	21.40	20.60	.39	.23					
	Average, Cupertino		**22.33**		**.53**	**.14**					
	Average, Mission San Jose		**23.37**		**.50**	**.21**					
	Average, Paso Robles		**24.93**		**.36**						
	Average, Tulare		**24.58**	**22.52**	**.38**	**.23**					
	Sultana.										
774	Cupertino	1887	26.10	26.31	.41	.34	13.27			.47	2.30
892	Cupertino	1888	22.97	23.13	.49	.27	13.09			.48	2.70
893	Cupertino	1888	26.51	27.65	.39	.29					
1356	Mission San José	1890	26.60		.54						
1711	Mission San José	1892	25.00	25.19	.62	.25	11 91			.61	2.70
2066	Mission San José	1893	27.15		.60						
2245	Mission San José	1894	26.00		.56						
1483	Fresno	1891	22.11	21.22	.60		*19.08			.44	*3.30

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* Fortified.

SUMMARY OF ANALYSES OF MUSTS AND WINES OF RAISIN, TABLE, AND OTHER GRAPES—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric. At Pressing	Total Acid as Tartaric. At 6 to 8 Months	Body
	Sultana—Continued.										
1715	Tulare	1892	21.20	-----	.30	-----	-----	-----	-----	-----	-----
	Average, Cupertino	-----	**25.19**	**25.69**	**.43**	**.30**	**13.18**	-----	-----	**.47**	**2.50**
	Average, Mission San Jose	-----	**26.18**	**25.19**	**.45**	**.25**	**11.91**	-----	-----	**.61**	**2.70**
	Thompson's Seedless.										
1376	Cupertino	1890	26.92	-----	.45	-----	-----	-----	-----	-----	-----
1636	Tulare	1892	24.45	-----	.33	-----	-----	-----	-----	-----	-----
1894	Tulare	1893	25.05	-----	.37	.31	-----	-----	-----	-----	-----
	Average, Tulare	-----	**24.75**	-----	**.35**	**.31**	-----	-----	-----	-----	-----
	BLACK TABLE-GRAPES.										
	Black Hamburg and Black Prince.										
781	Cupertino	-----	24.70	24.64	.53	.44	12.82	.240	.45	.45	3.10
1265	Cupertino	-----	15.87	-----	.54	-----	-----	-----	-----	-----	-----
1699	Tulare	1887	24.10	-----	.33	-----	-----	-----	-----	-----	-----
2003	Tulare	1890	23.70	22.40	.32	.50	10.75	.071	.33	.43	2.50
2347	Tulare	1892	23.70	-----	.18	-----	-----	-----	-----	-----	-----
1956	Paso Robles	1893	25.20	24.12	.42	.38	11.82	.102	.42	.46	2.80
	Average, Cupertino	1894	**20.28**	**24.64**	**.53**	**.44**	**12.82**	**.240**	**.45**	**.45**	**3.10**
	Average, Tulare	1893	**23.83**	**22.40**	**.28**	**.50**	**10.75**	**.071**	**.33**	**.43**	**2.50**
	Gros Colman.										
1269	Cupertino	1890	14.70	-----	.57	-----	-----	-----	-----	-----	-----
1425	Mission San José	1890	21.95	-----	.42	-----	-----	-----	-----	-----	-----
1932	Paso Robles	1893	15.20	-----	.40	.33	-----	-----	-----	-----	-----
1973	Tulare	1893	21.50	-----	.41	.33	-----	-----	-----	-----	-----

	Black Morocco.										
1351	Cupertino	1890	16.70		.65						
2024	Tulare	1893	20.20		.45						
	California Black Malvoisie.										
1478	Paso Robles	1891	22.80		.55						
1855	Amador station	1893	20.20		.60						
2194	Amador station	1894	23.40		.59						
2224	Amador station	1894	27.60		.43						
	Average, Amador station		**25.60**		**.54**						
	Cornichon.										
1350	Cupertino	1890	17.20		.68						
2007	Tulare	1893	19.30		.50						
	Emperor.										
1349	Cupertino	1890	19.30		.66						
2236	Mission San José	1894	15.40		.72						
	RED TABLE-GRAPES.										
	Barbarossa.										
746	Cupertino		24.60	23.61	.47	.42	12.64			.52	2.60
1266	Cupertino	1887	22.90		.58	.27					
2088	Cupertino	1890	24.80		.77						
1429	Mission San José	1893	28.50		.44						
1775	Mission San José	1890	22.85	23.13	.59		11.64			.65	2.44
1995	Mission San José	1892	24.80		.52						
2230	Mission San José	1893	22.80		.48						
1740	Paso Robles	1894	24.80		.37						
1980	Tulare	1892	21.50	20.69	.47	.30	10.25			.45	2.80
	Average, Cupertino	1893	**24.10**	**23.61**	**.61**	**.35**	**12.64**			**.52**	**2.60**
	Average, Mission San Jose		**26.38**	**23.13**	**.53**		**11.64**			**.65**	**2.44**
	Flame Tokay.										
1928	Natoma	1893	19.50		.36						
	WHITE TABLE-GRAPES.										
	Luglienga.										
1210	Fresno	1890	20.85		.32						
1214	Fresno	1890	20.85		.33						
1305	Cupertino	1890	24.25		.34						

SUMMARY OF ANALYSES OF MUSTS AND WINES OF RAISIN, TABLE, AND OTHER GRAPES—Continued.

Number	LOCALITY.	Vintage of	MUST.				WINE.				
			Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol by Volume	Tannin	Total Acid as Tartaric.		Body
									At Pressing	At 6 to 8 Months	
	Luglienga—Continued.										
2087	Cupertino	1893	28.00	....	.35	......	....	....	....	....	......
1441	Tulare	1891	23.70	....	.36	......	....	....	....	....	......
1812	Amador station	1893	21.10	....	.47	......	....	....	....	....	......
	Average, Fresno	......	**20.85**	....	**.33**	......	....	....	....	....	......
	Average, Cupertino	......	**22.13**	....	**.34**	......	....	....	....	....	......
	Pizzutello di Roma.										
2006	Tulare	1893	22.20	....	.38	......	....	....	....	....	......
	Almeria.										
2023	Tulare	1893	19.70	....	.54	......	....	....	....	....	......
	AMERICAN TYPE.										
	Herbemont.										
1386	Cupertino	1890	22.40	....	.69	......	....	....	....	....	......
2125	Cupertino	1893	24.40	....	.85	......	....	.163	.90	....	......
1749	Paso Robles	1892	23.70	....	.56	......	....	....	....	....	......
1767	Mission San José	1892	21.30	....	1.05	......	....	....	....	....	......
2001	Tulare	1893	20.20	....	.76	.37	9.27	.134	.75	.52	3.00
	Average, Cupertino	......	**23.40**	....	**.60**	......	....	**.163**	**.90**	....	......

NOTES ON RECENTLY IMPORTED GRAPES.

Of the most recently imported grapes in the collection obtained from Count S. di Rovasenda, of Turin, some varieties have commenced to bear at the Pomona and Tulare stations. At present but a partial report can be made on the character of their fruit and their adaptability to conditions existing in California; but the following notes are given for the benefit of those who have received cuttings of these varieties. They are principally Italian grapes, many from northern Italy (whence we have already obtained some of our most promising varieties), but others from Sicily, Sardinia, and southern Italy—localities whose grapes are as yet quite untried in California.

All the varieties have grown vigorously at Berkeley, where, however, they have all failed to mature any fruit. Their unsuitableness to cool localities is well illustrated in Berkeley by their failure to ripen perfectly their wood side by side with French varieties, nearly all of which mature their canes without difficulty.

Pelaverga (syn., Cari).—Robust and productive; bunches large; berries large, reddish-black, very sweet, and keeping well through the winter. Used for the production of a sweet, sparkling wine in the country around Saluzzo, but more suitable for a table-grape than for wine.

Zinzillosa (syn., Tintorina).—Resembles the Mourastel.

Bolgnino (syn., Nebbiolo di Dronero).—Cultivated near Saluzzo, in Piedmont, and differing very much from the true Nebbiolo. This variety has fruited at Tulare, and a sample of the grapes was received from there on October 14, 1895, in good condition. The must showed 24.6% of solid contents by spindle and 0.48% of acid. The bunches were small, compact, cylindrical, on heavy peduncles; the berries small, round, juicy, sweet, and of good flavor. A few of the grapes were sun-dried, and in general they resembled a Pinot.

Crovattina (syn., Croattina, Nebbiolo di Gattinara).—Grown in various parts of Piedmont and Lombardy. It has large, round, black berries, resembles the Bonarda more than the Nebbiolo, and gives a common wine of good color. It is a heavy bearer, but needs a deep soil.

Negrara di Gattinara.—A black wine-grape, cultivated in the extreme north of Piedmont.

Erbalus di Caluso.—It is from this grape that the liqueur wines of Caluso are made. On account of its thick skin and firm pulp it is a good keeper and very suitable to partial drying before crushing, as is done in making the liqueur wines of Caluso. It is not a heavy bearer, and requires long-pruning.

Description: Leaves of medium size, thin and smooth, dark green and slightly tomentose on the lower surface, sharply toothed, and deeply five-lobed; bunches cylindrical and with small wings; berries of medium size, round, thick-skinned, yellowish at first, becoming rose-colored.

This variety has fruited at the Pomona station, and on September 14, 1895, a sample of the grapes was received in good condition. The must showed 23.0% of solid contents by spindle and 0.62% of acid. The bunches were of medium size, cylindrical, well filled, on slender peduncles; the berries of medium size, nearly round, pulpy but soft, thick-skinned, from green to pink in color, on short, slender pedicels, not of very agreeable flavor, but mature and having good acid.

Grisa di Piemonte.—A valued table-grape of northern Italy. The bunches are large, conical, and well filled; the berries large, slightly oval, pulpy but soft, black, but grayish in appearance on account of their abundant bloom.

Antibo.—A large, black table-grape of Saluzzo, Piedmont. The grapes are said to be very crisp and agreeable.

Quagliano.—A large, black table-grape grown in the neighborhood of Cuneo, Piedmont, in light soils. It is of very delicate and agreeable flavor. A sample of the fruit of this variety was received from the Tulare station on October 14, 1895, in good condition. The must showed 23.9% of solid contents by spindle and 0.38% of acid. The bunches were of medium size, conical, and well filled; the berries large, round, crisp, rather astringent, of good flavor, and with tender skin. It was a very pleasing and fine looking table-grape, but not firmly enough attached to the pedicel for distant shipment. It resembled the Gros Colman.

Bermestia Rossa or Violetta.—A large table-grape cultivated in Lombardy and other parts of northern Italy. The bunches are large, loose, long, conico-cylindrical, on long, slender peduncles; the berries very large, long-olive-shaped, on long, slender pedicels; the skin is thick, violet-red; the flesh firm and of neutral flavor.

Bitondo.—A grape grown on the Adriatic side of central Italy. The grapes are large, round, of brick-red color; the bunches on long peduncles with distinct wings.

Malvasia Rovasenda.—A seedling originated by Baron Mendola, of Favara, Sicily.

Malvasia di Broglio.—Grown in Tuscany and Apulia, and in many other parts of Italy. It is a vigorous grower and good bearer, and resists the *oidium* well. A sample of the grapes was received on September 27, 1895, in good condition. The must showed 25.9% of solid contents by spindle and 0.45% of acid. The bunches were large, irregular, with many long cylindrical branches, well filled; the berries were small, round, firm, fleshy, with little flavor, resembling the Sherry grapes in character.

Negro Amaro (syn., Lacrima).—A wine variety of Apulia; said to be too late for northern Italy. A sample was received from Tulare in good condition. The must showed 25.9% of solid contents by spindle and 0.65% of acid. The bunches were of medium size, conico-cylindrical, compact, on heavy peduncles; the berries of medium size, slightly oblong, firm, juicy, thick-skinned, with fair color, of fresh and agreeable flavor. The grapes resemble the Chauché noir, but have better color and more flavor.

Cesanese.—A vine of central Italy, with black, oval grapes.

Trivoti.—A vine cultivated in Sicily. The grapes are large, ellipsoidal, light violet or marked with reddish-brown blotches.

Negro Dolce.—A vine cultivated in Apulia.

Catarrattu a la Porta.—A white grape of Sicily, which enters into the manufacture of the wines of Marsala. It has large, round, yellow berries, and bears well.

Mammolo Toscano.—Said to give a wine having a faint flavor of violets. It is cultivated in Tuscany, and is rather too late for more northern localities. The grapes are oval and black.

Pagadebito.—This name, which means "pay debt," is given to several heavy-bearing grapes in various parts of Italy. The one planted at the Experiment Stations seems to be the Pagadebito which occupies a large part of the vineyards along the whole Adriatic slope of the Apennines. It is vigorous, robust, and bears well. A sample of the grapes was received from Tulare on October 14, 1895, in good condition. The bunches were small, cylindrical, well filled, each with a small wing; the berries small, round, juicy, firm, with very thick and astringent skin, good color and flavor, but lacking in acid. Many of the berries were small and abortive. The must showed 21.7% of solid contents by spindle and 0.41% of acid.

Vernaccia Sarda (syn., Austera).—A heavy-bearing white-wine grape of Sardinia. It gives a lighter wine than most of the vines of Sardinia, and is very agreeable, though somewhat rough and a little bitter.

Monica (syn., Munica, Nectarea).—This variety produces the most valued wine of Sardinia. It is a strong grower, somewhat resembling the Mission. A sample of the grapes was received from Tulare on October 15, 1895, in good condition. The bunches were very large, conical, heavily shouldered, well filled; the berries over medium, round, firm, well attached to the pedicel, of good flavor and very sweet, of a dull brownish-purple color. It is an agreeable eating-grape and probably a good shipper, on account of its beautiful bunches, which, though very large, adapt themselves well to packing. The must showed 27.4% of solid contents by spindle and 0.24% of acid.

Ocru di Boe.—A black grape of Sardinia. It has large, conico-cylindrical bunches, very large, oval berries, which are firm, thin-skinned, and of good flavor. It ripens late.

Cipro Nero.—From this grape the most famous wine of the Island of Cypress is made. A sample of the fruit was received from Tulare on October 14, 1895, in good condition. The bunches were of medium size, loose, on slender peduncles; the berries large, ovoid, firm, with thick but tender skin, and good flavor. It appeared to be a good shipping-grape, somewhat resembling the Black Prince, but with less color and more flavor. The must showed 23.0% of solid contents by spindle and 0.42% of acid.

Danugue (syn., Gros Guillaume).—A late table-grape of southern France. The bunches are large, branching, and loose; the berries large, ellipsoidal, firm, juicy, of neutral flavor, and with a very thick, tough skin, of dull black color.

Olivette de Cadenet (syn., Teneron).—A good late table-grape. A sample of the fruit was received from Pomona on September 14, 1895, in good condition. The bunches were large, loose, long-conical, on slender peduncles; the berries large, ellipsoidal, firm, fleshy, with thick but tender skin, and little flavor. Apparently an excellent shipping-grape of green to yellowish color.

Picpoule.—This is one of the most widely cultivated grapes of the south of France. It is a heavy bearer and especially adapted to close, head pruning. Its bunches are of medium to large size, conico-cylindrical, winged; the berries are nearly round and of medium size. It was the principal black grape of Languedoc until it was abandoned in favor of the Aramon, on account of its extreme liability to attack of *oidium.* Now that the *oidium* is successfully combated by sulphur, this variety may be worth trying in California, on account of its vigor, fertility, and adaptability to poor soils.

Aspiran noir.—This is the white variety of the Verdal, and is more esteemed in France than the latter, both for wine-making and for the table.

Persan.—This is one of the most valued grapes of Isère and Savoy for red wine. It is, however, generally considered inferior to the Etraire de l'Adhui, which it resembles closely.

Chenin noir.—This is one of the chief red-wine grapes of the department of Maine-et-Loire, in the west of France, where it gives good crops, but ripens rather late.

WINES RECEIVED FOR EXAMINATION.

RED WINES.

No. 1208R. *Cabernet Sauvignon,* from Jos. Sladky, Mountain View; received February 14, 1890. Condition good, color light for the variety, acid slightly deficient.

No. 1632R. *Cabernet Sauvignon,* vintage of 1885, from Wm. Pfeffer, Gubserville; received and analyzed April 1, 1892. Color much less than in the following samples of Cabernets from the same place; 19.10 in intensity and verging toward yellow in tint.

No. 1633R. *Cabernet Sauvignon,* vintage of 1887, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color much more intense than in the 1885 sample, 34.80 as against 19.10 for the earlier vintage.

No. 1640R. *Cabernet Sauvignon,* vintage of 1889, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, 38.10 in intensity; tint, red.

No. 1634RI. *Cabernet Sauvignon,* vintage of 1890, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, V.R.—63.5.

No. 1635RII. *Cabernet Sauvignon,* vintage of 1890, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, V.R.—60.6; taste, intensely "tannic." Apart from the sugar still present, the wine is heavy-bodied. The alcoholic contents of this wine having nearly reached the possible limit, the wine hardly runs any risk from the sugar that it contains.

No. 1636R. *Cabernet Sauvignon,* vintage of 1891, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, V.R.—83.3.

No. 2582. *Cabernet Sauvignon,* vintage of 1889, from Wm. Pfeffer, Gubserville. Condition good; color bright; body high; wine contains a considerable amount of carbonic acid gas.

No. 2596. *Cabernet Sauvignon,* vintage of 1893, from Wm. Pfeffer, Gubserville; received February 28, 1894. Pomace was taken away from must two days after crushing. Color, 4V.R.—30.5; body and color, light; a tart, pleasant wine. The effect of early drawing off from the pomace in reducing the tannin contents of the wine is well shown in this wine.

No. 2597. *Cabernet Sauvignon,* vintage of 1893, from Wm. Pfeffer, Gubserville; received February 28, 1874. Fermented on ¼ pomace. Wine somewhat rough; color more bluish than No. 2596, and read 2V.R.—61.50.

No. 2618. *Cabernet Sauvignon,* vintage of 1891, from Grau & Werner, Irvington, Alameda County; received July 16, 1895.

Nos. 2584–88, 2593–94. *Cabernet Sauvignon*, from T. Parrott, St. Helena. No. 2584 is from the vintage of 1889; No. 2585, vintage of 1890; No. 2586, vintage of 1891; No. 2587, vintage of 1892; No. 2588, vintage of 1893; No. 2593, vintage of 1893 (press wine); No. 2594, vintage of 1893.

The above seven samples of Cabernet Sauvignon wines were received from the late Tiburcio Parrott, of St. Helena, Napa County, on October 6, 1893. They were obtained with the object of showing that California wines made from the typical Medoc varieties of grapes, even wines which are acknowledged to be among the best of their class, are always excessively rich in tannin; that is to say, their astringency is much higher than that of the French Medocs of commerce. A comparison of the analyses of these wines with some recent analyses made by Messrs. N. Gayon, Ch. Blarez, and E. D. Dubourg, of the University of Bordeaux, is very instructive. In twenty-one of the best wines of the Medoc region they found the tannin to range from 0.190% to 0.270%, the average being 0.210%. As the table shows, the St. Helena wines ranged from 0.385% to 0.573%, and averaged 0.483%, which is more than twice as much as is shown by the French Medocs. This explains very clearly why our finest Cabernet Sauvignon wines are not appreciated by many who are used to the smoother French clarets. The mistake made by our wine-makers is in supposing that, to produce a wine of the character of the finest Château wines, they must keep the high-class Medoc grapes undiluted with any grapes of inferior quality. The fact is that all French Medocs are made by blending the highly characterized wines with smoother and more neutral ones. This is generally done in the fermenting-vat, but very often in the cellars, of the Bordeaux wine-handlers.

The finer the quality of a pure Cabernet Sauvignon wine, the more intensified, very often, are its characteristics. It should be looked upon as a concentrated liquid, almost an essence, containing all desirable ingredients, but in too condensed a form to be agreeable to the palate or to be used as a regular table-wine; but to be used to obtain the exact kind of wine desired by the average consumer, by means of blending with clean, fresh-tasting wines of similar but less marked character. It might not be amiss to call attention to the fact that perhaps a great part of the popularity of the Zinfandel is due to the fact that the absolute and relative amounts of its various ingredients generally approach more closely, naturally without blending, to the genuine Claret type than do other varieties which in other respects are much superior to it.

No. 2620. *Cabernet blend*, from Grau & Werner, Irvington, Alameda County; received July 16, 1895.

Nos. 2621 and 2622. *Zinfandels*, vintages of 1893 and 1894, respectively; samples sent by Grau & Werner, Irvington, Alameda County; received July 16, 1895.

The analyses of samples Nos. 2618, 2620, 2621, 2619, and 2622, given in the table, represent the normal composition of wines made from grapes grown on the uplands lying between Mission San José and Irvington, California; well known for the quality of their products. They are pure, natural wines; the small amount of boracic acid shown being derived from the soil which in the northern part of this State always contains more or less of this ingredient, and which is taken up by the vine here, as in Tuscany, Italy.

No. 1207R. *Blend of Cabernet Sauvignon and Malbeck*, from Wilkins & Co.; received February 1, 1890.

No. 1631R. *Verdot*, vintage of 1891, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, 2V.R.—129.3. A heavy-bodied wine apart from the sugar which it still contains; but there is no obvious reason why this wine should not have fermented out. The acid is very high, yet it does not appear so to the tongue, because of the sugar and tannin, which interfere with its perception. No unsound germs are yet present, however.

Nos. 1637R and 1638R. *St. Macaire*, of vintage of 1890 and 1891, respectively; samples sent by Wm. Pfeffer, Gubserville; received April 1, 1892. No. 1637R, color 2V.R.—57.90; No. 1638R, color V.R.—80.00.

No. 1639R. *Mondeuse*, vintage of 1891, from Wm. Pfeffer, Gubserville; received April 1, 1892. Color, 2V.R.—49.4.

The wines of the district represented by Gubserville are favored with a very unusual amount of tannin. There need be no doubt that the St. Macaire, in this locality, is a genuine Bordeaux, or Claret grape, for both in acid and in tannin it comes fully up to the type, the Cabernets.

Nos. 1622R and 1623R. *Zinfandels*, vintage of 1890, respectively first and second crop; sent by A. Salazar, Mission San José. The wines were examined as to differences in acid, and the result indicates there was no perceptible difference.

No. 1624R. *Blend of Mataro and Zinfandel*, vintage of 1888; sample sent by A. Salazar, Mission San José, April 22, 1891. It contained 0.69% of total acid as tartaric, and 0.09% of volatile acid.

No. 2591. *Alicante Bouschet*, vintage of 1893, from I. de Turk, Santa Rosa; sample received and analyzed December 20, 1893.

No. 2592. *Petit Pinot*, vintage of 1893, from I. de Turk, Santa Rosa; received December 20, 1893.

No. 2599. *Black Pinot*, vintage of 1889, from P. B. Cornwall, Santa Cruz; received and analyzed for acid August 27, 1894.

No. 1218R. *Malvasia*, vintage of 1890, from H. W. Crabb, Oakville; received February 26, 1891. Samples of wines from two tanks, which showed at crushing on October 25, 1890, 40% of sugar; they were crushed cold and have fermented very slowly, still showing 10% and 12% of sugar, respectively.

WHITE WINES.

No. 1204R. *Blend of Chauché gris and Chauché noir*, vintage of 1889, from Wilkins & Co. Wine quite turbid; color light amber; bouquet characteristic; acid not high, but leaves a slight roughness in the throat; taste alcoholic. A microscopic examination of the sediment showed some lactic and a few "effete" yeast germs.

No. 1205R. *Blend of white wines*, vintage of 1889, from Wilkins & Co.; received and analyzed February, 1890. Condition turbid; color pink-red; acid medium; taste not sweet. A microscopic examination of the sediment of the wine showed a very little acetic ferment and some lactic germs, as well as dead yeast-cells.

No. 2595. *Pedro Jimenes*, from J. Bergin, Mountain View; received February 27, 1894.

No. 2628. *Sauvignon vert*, vintage of 1895, from R. Schmidt, Calistoga; received and analyzed February 14, 1896.

No. 2624. *Sauvignon blanc*, vintage of 1893, from G. F. Merriam, Twin Oaks, San Diego County.

No. 2625. *Sauvignon blanc*, vintage of 1894, from G. F. Merriam, Twin Oaks, San Diego County.

No. 2626. *Sauvignon blanc*, vintage of 1895, from G. F. Merriam, Twin Oaks, San Diego County.

The above three wines, though made from Sauvignon blanc, were in no sense Sauternes, but were fortified wines with high sugar contents, which conformed to no type, but were fairly agreeable liqueur wines.

No. 2676. *Riesling*, vintage of 1895, from R. Schmidt, Calistoga; received and analyzed February 14, 1896.

Nos. 1202R and 1203R. *Rieslings*, vintages of 1888 and 1889, respectively; sent by W. G. Klee, January 6, 1890, from Glenwood, Cal. No. 1202R wine in good condition, smooth taste and clean; acid pleasant, but high. No. 1203R wine had fine aroma and high acid; was rendered very pungent by large contents of carbonic acid gas.

No. 2583. *Green Hungarian*, vintage of 1892, from Geo. Husmann, Napa; received and analyzed August 24, 1893.

Nos. 2576 and 2577. *Sauvignon vert*, from F. Sierus, Rutherford, Napa County. Both sound and clean-tasting wines of bright condition and pleasant acid. No. 2577 of more pronounced bouquet and flavor than No. 2576, which, on the whole, does not promise to be a wine of as high quality as No. 2577.

MISCELLANEOUS PRODUCTS.

The nature of the request which accompanied each sample will be understood by the description given. The results of analyses and methods of treatment are detailed under each number as it occurs.

No. 1209. *Champagne*, from Wm. Rueff, San Francisco; received and analyzed February 14, 1890. The sample contained a troublesome black sediment, which, when examined microscopically, showed no definite form. Upon heating the wine the sediment apparently dissolved. Tests showed the presence of lead, but no tin.

No. 2614. *Sample of Wine*, from Santa Clara Valley; thought to be "over fined." The wine showed 0.268% of albuminoids (nitrogenous matter); not an amount in excess of that usually contained in wines of its kind.

No. 2598. *Orange Wine*, from Kinton Stevens, Santa Barbara; received August 13, 1894. The sample contained 17.50% of alcohol by volume, 0.44% of citric acid, and 3.30% of solids. Orange wine is essentially a fortified wine, which may or may not retain a taste of orange peel, according to the methods used in the manufacture. The above sample resembled Sherry and bore no trace of orange peel to the taste. Owing to the amount of labor necessary in the manufacture of this wine, the amount of sugar and acid necessary to be added, as well as of alcohol, this industry does not seem to be profitable. By crushing the skins and not peeling the oranges, a very agreeable liqueur can be made at less expense than the dry orange wine.

No. 1619. *Sherry*, from Santa Clara Valley. A small sample was received April 1, 1891. The wine had become bitter from treatment with powdered limestone. Its total acid content as tartaric was determined to be 0.25%. Upon the addition of carbonate of soda to the extent of 0.25% the wine showed no precipitate of lime and still had an acid reaction. Double the above amount of carbonate of soda was added, when a large precipitate of lime appeared; this was allowed to settle and the clear wine aërated; a little more fine precipitate appeared. This experiment certainly lessened the *bitterness*, but the soda gave a *mawkish* taste to the wine.

No. 1620. *Sherry*, from Santa Clara Valley; received April 7, 1891. A larger sample of the same wine as No. 1619, but containing a little more acid, or 0.32% represented as tartaric acid; fully one third of this acid was acetic acid. This sample was treated with a slight excess of potassium carbonate, which produced a voluminous light brown precipitate—largely lime. After aërating the clear liquid and allowing the small precipitate thus produced to settle out, the acid was brought to its original amount by the addition of tartaric acid. This experiment rendered the Sherry smooth and not nearly so bitter as when received. By treating the wine with a slight excess of carbonate of potash, removing the resulting precipitate either by filtration or racking, and then bringing the total acid to 0.52% as tartaric, by the addition of that acid, the Sherry was rendered smooth and all the bitterness apparently disappeared.

No. 2600. *Prune Juice;* sample received October 8, 1894, from Prof. Rising, requesting the percentage of alcohol, which was found to be 17.10% by volume.

No. 2602. *Vinegar*, from R. E. Beckweth, Fresno; received November 29, 1894. This sample was claimed to be pure cider-vinegar. It contained 7.29% of acetic acid—rather more than cider-vinegar, which commonly contains from 3.5% to 6.0%.

Nos. 2605 and 2611. *Vinegars*, from Jenison & Strine Bros., of Downey, Los Angeles County. These samples were sold for pure cider-vinegar. No. 2605 was received February 14, 1895, and contained 7.38% of acetic acid. No. 2611 was a larger sample of the same vinegar, and was received April 4, 1896; this yielded 8.07% of acetic acid, 0.74% of extract, and only traces of malic acid. This goes to show that the sample is not pure cider-vinegar, for the extract (0.74%) is just about one half the quantity contained in cider-vinegar; malic acid, a constituent of cider-vinegar, is almost lacking, and the high acetic acid content (8.07%) is over 2% more than the maximum acetic acid in cider-vinegar.

No. 2610. "*Unfermented Wine*," from W. S. Austin, San Diego, Cal.; received March 26, 1895. This wine was sold as a curative for throat and lung troubles. Upon opening the bottle a strong odor of sulphurous acid was noticed; when the sample was heated this acid was strongly evolved. The sample was found to contain 0.596 gram of sulphurous acid per liter (0.0596%), which amount is, of course, too great to be taken into any stomach. Besides the above work this wine was tested for salicylic and boracic acids; however, neither of these antiseptics was present. The liquid showed 22.0% of solid contents and 0.588% of total acids reckoned as tartaric acid. These "unfermented wines" are getting to be quite common in the State. As a matter of fact, they are not wines at all, but merely grape juice, to which some powerful antiseptic has been added; in many cases salicylic acid, boracic acid, etc., are used. So far as is known, the only "unfermented wines" that are not apt to contain injurious additions are those in which the fermentation has been prevented by the use of heat—pasteurization. The "secret process" of making these so-called "wines" often means that if the ingredients were known, the sale of the "wine" would be impossible.

No. 2629. *Norton's Virginia Seedling Wine*, from Wm. Hotopp, Penn Park Vineyards, Charlottesville, Virginia. This sample was obtained in Virginia by Mr. James P. Langhorne, of San Francisco, and was given to the University for testing. The importance of the sample arises from the fact that the wine is made from "Norton's Virginia," a hybrid that has been highly spoken of as a direct producer—that is to say, a vine that not only resists the phylloxera, but also, without grafting, yields grapes that are said to make good wine. It was found that although the wine was better than that made from most of the American hybrids, such as the Herbemont, etc., yet the "foxy" or musky taste was so prominent as to preclude its use as a true Claret grape. The characteristic "dropping of color" after the wine was made was as strong as noted in the case of wine made from the Lenoir; while the excess of tannin and marked harshness made it a wine that would be useless on the markets of any part of the world, except the locality where it originated, and where the people have become accustomed to these peculiar flavors and aromas. Already in this State "Norton's Virginia" has been highly recommended by some, both as a stock and as a direct producer. Its feeble resistance to the phylloxera when moved from its native habitation, and its peculiarities of taste, however, render it a useless variety for California.

ANALYSES OF WINES SENT TO THE STATION FOR EXAMINATION.

Serial Number	Variety and Vintage.	Sender.	Place of Production.	Date of Analysis.	Alcohol.		Tannin	Acid.		Body, or Solids	Sugar	Ash
					By Weight	By Volume		Total as Tartaric	Volatile as Acetic			
	RED WINES.											
	Dry Red Wines.											
1208R	Cabernet Franc	Jos. Sladky	Mt. View, Santa Clara Co.	Feb. 14, 1890	9.78	12.18	.195	.38		2.70		
1632R	Cabernet Sauvignon, 1885	Wm Pfeffer	Gubserville	April 1, 1892	10.81	13.27	.360	.67		3.10		
1633R	Cabernet Sauvignon, 1887	Wm. Pfeffer	Gubserville	April 1, 1892	11.23	13.73	.424	.64		2.55		
1640R	Cabernet Sauvignon, 1889	Wm. Pfeffer	Gubserville	April 1, 1892	11.23	13.73	.402	.59		2.60		
1634R	Cabernet Sauvignon, 1890	Wm. Pfeffer	Gubserville	April 1, 1892	10.81	13.25	.405	.55		2.05		
1635R	Cabernet Sauvignon, 1890	Wm. Pfeffer	Gubserville	April 1, 1892	12.54	15.40	.573	.49		3.23	0.22	
1636R	Cabernet Sauvignon, 1891	Wm. Pfeffer	Gubserville	April 1, 1892	11.54	14.10	.516	.48		2.80		
2582	Cabernet Sauvignon, 1892	Wm. Pfeffer	Gubserville	Aug. 16, 1893	9.34	11.64	.408	.47		2.60		
2584	Cabernet Sauvignon, 1889	T. Parrott	St. Helena	Oct. 6, 1893			.448	.63				
2585	Cabernet Sauvignon, 1890	T. Parrott	St. Helena	Oct. 6, 1893			.573	.57				
2586	Cabernet Sauvignon, 1891	T. Parrott	St. Helena	Oct. 6, 1893			.448	.67				
2587	Cabernet Sauvignon, 1892	T. Parrott	St. Helena	Oct. 6, 1893			.488	.44				
2588	Cabernet Sauvignon, 1893	T. Parrott	St. Helena	Oct. 6, 1893	9.78	12.20	.495	.53				
2593	Cabernet Sauvignon, 1893	T. Parrott	St. Helena	Dec. 20, 1893			.544					
2594	Cabernet Sauvignon, 1893	T. Parrott	St. Helena	Dec. 20, 1893			.384					
2590	Cabernet Sauvignon, 1893	I. De Turk	Santa Rosa	Dec. 20, 1893			.502					
2596	Cabernet Sauvignon, 1893	Wm. Pfeffer	Gubserville	Feb. 28, 1894	11.62	14.20	.208	.49		2.70		
2597	Cabernet Sauvignon, 1893	Wm. Pfeffer	Gubserville	Feb. 28, 1894	12.77	15.70	.307	.60		2.60		
2618*	Cabernet Sauvignon, 1891	Grau & Werner	Irvington	July 16, 1895	9.66	12.05		.68	.07	2.80	0.17	.22
1207R	Blend (Cabernet Sauvignon and Malbeck)	Wilkins & Co.		Feb. 1, 1890				.37		2.70	0.00	
2620*	Cabernet blend	Grau & Werner	Irvington	July 16, 1895	10.21	12.80		.64	.08	2.71	0.13	.25
1637R	St. Macaire, 1890	Wm. Pfeffer	Gubserville	April 1, 1892	11.08	13.54	.538	.60		2.85		
1638R	St. Macaire, 1891	Wm. Pfeffer	Gubserville	April 1, 1892	9.92	12.36	.456	.47		3.00		
1639R	Mondeuse, 1891	Wm. Pfeffer	Gubserville	April 1, 1892	10.91	13.36	.471	.47		2.55		
1631R	Verdot, 1891	Wm. Pfeffer	Gubserville	April 1, 1892	10.35	12.82	.420	.86		3.02	0.58	
1622R	Zinfandel, 1890 (first crop)	A. Salazar	Mission San José	April 22, 1891				.66				
1823R	Zinfandel, 1890 (second crop)	A. Salazar	Mission San José	April 22, 1891				.65				

2589	Zinfandel, 1893	I. De Turk	Santa Rosa	Dec. 20, 1893			.291					
2621*	Zinfandel, 1893	Grau & Werner	Irvington	July 16, 1895	10.14	12.70		.57	.06	2.68	0.16	.22
2622*	Zinfandel, 1894	Grau & Werner	Irvington	July 16, 1895	10.21	12.80		.57	.13	3.24	0.31	.23
1624R	Blend (Mataro and Zinfandel), 1888	A. Salazar	Mission San José	April 22, 1891				.69	.09			
2591	Alicante Bouschet, 1893	I. De Turk	Santa Rosa	Dec. 20, 1893			.445					
2592	Petit Pinot, 1893	I. De Turk	Santa Rosa	Dec. 20, 1893			.361					
2599	Black Pinot, 1889	P. B. Cornwall	Santa Cruz	Aug. 27, 1894				.42				
2619*	Petit Pinot, 1891	Grau & Werner	Irvington	July 16, 1895	9.98	12.60		.68	.11	2.70	0.14	.26
1218R	Malvasia (tank No. 1, tank No. 2), 1890	H. W. Crabb	Oakville	Feb. 26, 1891	10.50 10.52	13.90 13.81				16.10 14.70		
	Unclassified Red Wines.											
1206R	Mixed reds	Wilkins & Co.		Feb. 18, 1890				.40		2.60		
1629R	Red wine	M. Baumard	San Francisco	Dec. 4, 1891	10.80	13.91				7.30		
2579	Red wine	Solis Wine Co.	Gilroy	June 28, 1893				.49	.07			
2580	Red wine	Solis Wine Co.	Gilroy	June 28, 1893				.64	.13			
2581	Red wine	Solis Wine Co.	Gilroy	June 28, 1893				.65	.08			
2603†	Red wine	J. H. Hague	Gilroy	Dec. 10, 1894				1.42	.74	9.10	3.25	
2604‡	Red wine	J. H. Hague	Gilroy	Dec. 10, 1894				.98	.10	4.60	.25	
2606	A, red wine	Solis Wine Co.	Gilroy	Feb. 18, 1895			.169	.60	.18	2.70	trace	
2607	B, red wine	Solis Wine Co.	Gilroy	Feb. 18, 1895			.170	.61	.08	2.85	trace	
2608	C, red wine	Solis Wine Co.	Gilroy	Feb. 18, 1895			.215	.50	.07	2.70	trace	
2609	D, red wine	Solis Wine Co.	Gilroy	Feb. 18, 1895			.232	.40	.10	2.99	1.41	
2612	Red wine	J. A. Sladky	Mt. View	Apr. 4, 1895	10.69	13.25		.55		2.30		
2613	Red wine	W. E. Hague	Gilroy	May 9, 1895			.189					
1625R	Red wine	E. H. Guppy	San José	Apr. 29, 1891	10.63	13.09				2.60		
2615	Red wine blend	Grau & Werner	Irvington	June 25, 1895	9.70	12.09		.53				
2616	Red wine blend	Grau & Werner	Irvington	June 25, 1895				.72	.15			
2617	Red wine blend	Grau & Werner	Irvington	June 25, 1895	9.63	12.00		.65	.19			
2623	Red wine	W. E. Hague	Gilroy	Nov. 4, 1895	10.28	12.75		.70		2.60		
2630	Red wine, 1891	Solis Wine Co.	Gilroy	Apr. 16, 1896						2.60	trace	
2631	Red wine, 1893	Solis Wine Co.	Gilroy	Apr. 16, 1896						2.50	trace	
2632	Red wine, 1892	Solis Wine Co.	Gilroy	Apr. 16, 1896						2.60	trace	
2633	Red wine, 1892	Solis Wine Co.	Gilroy	Apr. 16, 1896						2.60	trace	
2629	"Virginia Seedling"	Wm. Hotopp	Charlottesville, Va.	Mar. 11, 1896	8.23	11.45	.490	.79		3.10		
	Ports.											
1615R	Port	J. Gallegos	Mission San José	Feb. 7, 1891	15.49	19.49				5.60		
1616R	Port	J. Gallegos	Mission San José	Feb. 13, 1891	13.45	17.20				8.55		
1617R	Port	M. M. Watson	Oakland, Cal.	Feb. 26, 1891	14.82	18.22				9.05		
1626R	Port	Barton Estate Co.	Fresno	Nov. 7, 1891	12.56	16.24	.248	.50		1.68	9.22	.28
1627R	Port	Barton Estate Co.	Fresno	Nov. 7, 1891	15.38	19.78	.346	.41		1.66	9.04	.21
2578	Port	Barton Estate Co.	Fresno	June 5, 1893	18.30	23.58				11.70		
2601§	Port	Barton Estate Co.	Fresno	Oct. 9, 1894		19.00		.93	.38	9.50		

ANALYSES OF WINES SENT FOR EXAMINATION—Continued.

Serial Number.	Variety and Vintage.	Sender.	Place of Production.	Date of Analysis.	Alcohol.		Tannin.	Acid.		Body, or Solids.	Sugar.	Ash.
					By Weight.	By Volume.		Total as Tartaric.	Volatile as Acetic.			
	WHITE WINES.											
2576	Sauvignon vert, 1895	F. Sievers	Rutherford, Napa Co.	June 20, 1895	9.92	12.36	......	.47	......	2.25	......	......
2577	Sauvignon vert	F. Sievers	Rutherford, Napa Co.	June 20, 1895	9.92	12.36	......	.47	......	2.10	......	......
2628	Sauvignon vert	R. Schmidt	Calistoga	Feb. 14, 1896	......	......	......	......	......	2.28	1.12	......
2624	Sauvignon blanc, 1894	G. F. Merriam	Twin Oaks, San Diego Co.	Feb. 6, 1896	......	19.00	......	......	......	4.60	......	......
2625	Sauvignon blanc, 1893	G. F. Merriam	Twin Oaks, San Diego Co.	Feb. 6, 1896	......	16.00	......	......	......	12.80	......	......
2626	Sauvignon blanc, 1895	G. F. Merriam	Twin Oaks, San Diego Co.	Feb. 6, 1896	......	21.00	......	......	......	13.10	......	......
2627	Riesling, 1895	R. Schmidt	Calistoga	Feb. 14, 1896	......	......	......	......	......	2.10	1.00	......
1202R	Riesling, 1888	W. G. Klee	Glenwood	Jan. 8, 1890	10.81	13.27	......	.72	......	2.20	......	......
1203R	Riesling, 1889	W. G. Klee	Glenwood	Jan. 8, 1890	8.48	10.58	......	.85	......	2.30	......	......
2583	Green Hungarian, 1892	Geo. Husmann	Rutherford, Napa Co.	Aug. 24, 1893	9.36	12.00	......	.65	......	1.80	......	......
2595	Pedro Jimenes	J. Bergin	Mt. View, Santa Clara Co.	Feb. 27, 1894	14.20	11.62	......	.45	......	2.30	......	......
1204R	Blend (Chauché gris and Chauché noir, 1889	Wilkins & Co.	......	Feb. —, 1890	......	......	......	.41	......	2.10	......	......
1205R	Blend "White mixed"	Wilkins & Co.	......	Feb. —, 1890	......	......	......	.47	......	2.10	......	......

* Boracic acid, well-marked test. † Mannite, 0.902. ‡ Mannite, 0.800. § Potasium sulphate, 0.39 per cent.

PART II.

Phylloxera; by A. P. Hayne.

Fermentation; by F. T. Bioletti.

1. General Principles of Fermentation.
2. Experiments with Pure and Selected Yeasts.
3. Fermentation at high temperatures with addition of various substances.
4. Experiments with color grapes.
5. Asaprol.

Nitrogen in Musts and Wines; by Geo. E. Colby.

Miscellaneous Notes; by F. T. Bioletti.

1. Preservation of Fresh Grapes.
2. Sunstroke of the Vine.
3. Botrytis Cinerea.

List and Contents of Viticultural Reports issued by the Experiment Station and the late Viticultural Commission.

PHYLLOXERA.

By A. P. Hayne.

There is, perhaps, no other insect known to man that has been as much written about as the phylloxera. Every language of the civilized world is represented in its bibliography. It is to be observed, however, that the most valuable and by far the most numerous works upon the phylloxera, and especially the means of combating it, are found in French literature. Although the first description of the insect was printed in English by Asa Fitch, State Entomologist of New York, and by the late lamented C. V. Riley, for many years Entomologist of the U. S. Department of Agriculture, and thus the insect was first observed and named by Americans, yet our literature on the subject is very limited indeed; the best works we have in English, as well as in most of the foreign languages, are either translations or résumés from the French. This is especially true of works describing the means of combating the insect. The reason for this peculiar state of affairs is that, though the phylloxera is an American insect, yet we never had to seriously consider it till long after it had destroyed millions of acres in other countries.

In answer to the question constantly asked by vine-growers, "What book on the phylloxera shall I read, and where can I get it?" let me say that the student not familiar with French should read the reports published by the College of Agriculture of the State University, and those of the late Viticultural Commission. There is no complete work published in English on the subject, but one must look through several publications or annual reports if he would gain all the information to be had. In these reports will be found sufficient details to gain a clear idea of the life-history of the phylloxera, as well as the means of combating it; and in these publications will be found a complete list of works published in all languages on the subject.

The most *incomplete* part of the literature, both American and foreign, is that which treats of resistant vines and their adaptation. The reason for this is, that the subject is so new that sufficient time has not elapsed to enable the authors to make use of complete returns from experimental vineyards and stations. It is the purpose of the College of Agriculture to embody in a special bulletin a summary of the knowledge thus far obtained, which will appear about December, 1896. In this the subject of resistant vines will be thoroughly discussed.

The viticultural staff of the College of Agriculture is always ready to answer questions relating to this or kindred subjects, as well as to make such inspection and investigation as may be called for.

Home of the Phylloxera.—The phylloxera is not a California insect; it was introduced into this State either directly from that part of the United States east of the Rocky Mountains, or indirectly from Europe after the trans-Atlantic invasion, or from both. It should be here noted, that the day for theorizing by amateurs in this matter is passed. It has been established beyond the possibility of a rational doubt that the phylloxera has existed on the American vines in their native forests for ages. That it exists and has existed on these American vines proves that these vines really do resist the attacks of the insect under certain conditions; but not, as many claim, that the insect cannot live on the roots of the American resistant vines. The phylloxera is always found on certain Eastern wild vines, only these vines are not killed by the sting of the insect, as is the case with the non-resistant European and Asiatic species.

In speaking of American vines we do not mean to imply that all resist equally well, or that all are of the same practical value even though the absolute resistance be the same. Some of the species are practically of no value, owing to the difficulty of propagation, either from cuttings or graft. It must also be remembered that the vines that are natives of the Pacific Coast have not been exposed to the ravages of the phylloxera until within a very few years, and thus it is that the same conditions do not obtain here as in the East.

It being granted, then, that California has been invaded by the phylloxera, having before been free from it, we are led to study the behavior of the insect rather in those countries that, like California, have been *invaded;* countries in which the phylloxera has encountered conditions differing from those existing in its native breeding-place. More especially do we look to those countries which, like California, use only the *Vitis vinifera*, or European species, instead of resistant American species. We thus have a much wider field, and are enabled to profit by the many years of experience of those who have wrestled with the problem for a longer time and in a more serious manner than ourselves. We can thus begin where they left off, and avoid making the same mistakes and repeating the very same experiments and failures which they experienced nearly a quarter of a century ago. Logical as this may seem, there are still some viticulturists who scorn to look beyond the borders of their own vineyards. This spirit of self-sufficiency is most fatal to any rational progress; and the sooner people admit that they do not in reality "know it all," the better it will be for the vine interests of the country.

Aside from the practical means of combating the phylloxera, it is very useful for us to study the behavior of the insect immigrant, in order to get a good idea of its biological changes under new conditions. It is very certain that the vast interests at stake, as well as the greater number of years of acute affliction, have caused the Europeans to make the most careful and thorough study of the insect itself, and the means of combating it. In America, then, we must draw most of our information from abroad.

The History of the Phylloxera in California has been told so often that we will give but a brief résumé, referring those desiring further information to the publications referred to in the beginning of this article. It is to be noted that we in California behaved, in regard to the pest, just as did the inhabitants of other countries. At first we made light of it; then we refused to allow it to be known how serious the trouble was, regarding it as an insult to be told that the pest had infected our vineyards. This is noted to-day in certain vineyards, such as those of the

Champagne region in France. There, quite recently, the peasants resented the imputation so strenuously that it took regiments of soldiers to enforce the quarantine rules laid down by the Government. In California, though we have had no bloodshed, there was much ill feeling engendered; so much so that even to this day some refuse to accept the inevitable, or to listen to those who would assist them.

At the beginning of the invasion of the pest, the State University undertook the study of the local biology of the insect; and its work in this regard stands true to-day, and has been confirmed by the best scientists of the world. Numerous systematic experiments suggested by vine-growers, chemists, and entomologists as to the means of combating the terrible insect, were undertaken. Some misapprehension exists in the minds of many as to the object of an experiment, and it may be well to call attention to the fact that *experiments are sometimes as valuable when they fail as when they are successful;* indeed, it may be said that *experiments never fail to do good.* If a supposed remedy is thoroughly tried and found to be useless, the experiment is valuable in showing that practical men will waste time and money in trying it again. It is by this system of exclusion that good and true remedies are found. It is proper to allude to this, because much has been written by irresponsible parties tending to cast ridicule on experiments that did not result in finding a practical remedy; as though remedies were *ever* found at once without preliminary trials. Thus, it was at one time suggested abroad that, as the fumes of mercury are fatal to the phylloxera, it might be possible to utilize this as a means of combating the insect on the roots of the vine. A series of experiments were undertaken in every country in the world by the best scientists and practitioners. At first it appeared as though the proposed remedy might be practical, owing to a misconception of the amount of mercury and the time necessary to saturate the soil with its fumes. Systematic experiments showed that the quantity necessary was too great to admit of practical use in vineyards on a large scale; and because this did not prove a "sure cure," some ignorant persons made, and indeed are now making, an outcry against all experimentation.

Among other facts brought out by the systematic investigations made by the College of Agriculture was the fact that the winged form of the phylloxera (and hence the sexual form) is comparatively scarce in California. This led some dilettanti who desired to pander to the popular ideas to proclaim loudly that there was really no danger from the phylloxera. They said that it had been "localized," and that owing to "climatic conditions" it would not spread. While it is perfectly true that, for some reason, the winged form is rarer in California than elsewhere, it is none the less true that it does exist; and therefore that the phylloxera will continue to spread and multiply.

This was pointed out by the College of Agriculture years ago, but was disregarded. To-day the truth of the predictions then made is verified in only too striking a manner. That little attention was given to these warnings was due to several causes, the most powerful one being that the price of wine fell to so low a point that many vine-growers did not wait for the phylloxera to destroy their vineyards; but anticipated certain destruction by rooting out the vines and planting other crops. In this way many vineyards that never should have been planted were gotten rid of, and, so far as it went, this was an advantage.

There are several reasons why the phylloxera spreads more slowly in this State than in other countries. The fact that the winged form is very rare is among the chief; and hence that infection comes mainly from the wingless insects, which must be bodily carried by persons, wagons, boxes, or implements, and cuttings—adds materially to the efficacy of this impediment. In our dry atmosphere the swellings resulting from the bite of the phylloxera are not so quick to develop and spread over the surface of the roots; for it must be remembered that the injury by the phylloxera to the vines arises not so much from the amount of sap that it sucks from the roots or leaves, but mainly from the swellings that form where the insect inserted its sucking apparatus, and which start decay of the roots. The richness and freshness of our soils, together with the slower progress of decay, often enable a healthy, well-cared-for vine to throw out new roots almost as fast as the old ones are destroyed. This gives our vines a longer lease of life after being attacked than is the case in other countries; but it is none the less true that in the end they succumb to the fatal attack of the insect.

Soon after the outbreak of the phylloxera in California, the State entrusted the viticultural interests to a picked commission of vine-growers, and for fourteen years the field work was taken out of the hands of the College of Agriculture, owing to the absence of appropriations. Although it had no money for field investigations, the College staff was many times requested to make such investigations at the expense of parties desiring them; and it was during some of these that it was found that, so far from the phylloxera having been "localized," as had been said, the regular course of events had been followed, as had been predicted years before. That is to say, there had been no "localization" at all, but the insect had spread unchecked from region to region, and is still spreading wherever there are vines to live upon. Thus, it was found to have existed in the well-isolated Livermore Valley for years, although these vineyards had been pronounced uninfested. It was found all through the Santa Clara Valley, on the top of the Santa Cruz Mountains, in the Alhambra Valley in Contra Costa County, and in hitherto uninfected parts of the Sacramento Valley, as well as elsewhere.

Just at this time a marked revival in the wine industry took place, and the State abolished the Viticultural Commission and turned over the technical work to the College of Agriculture and the United States Experiment Station connected with it. Owing to legal difficulties, the funds appropriated for that purpose did not become available for eight months afterward, so that active work under the new arrangement has but just begun, and active measures inaugurated to insure the vineyards all aid possible in combating the phylloxera and other vine pests. The results of this work will be given to the public in advance of the regular annual report in bulletin form, as the work progresses.

FERMENTATION.

By F. T. Bioletti.

GENERAL PRINCIPLES OF FERMENTATION.

With every new vintage it becomes more clearly understood that an exact knowledge of the fundamental principles of fermentation is essential to the constant production of good wine. If we would avoid the evils of stuck tanks, lactic, mousy, acetic wines, we must know the causes and conditions favorable to these evils, and how to remedy them. Even leaving aside the unsound wines, of which I will venture to say every cellar produces more or less, it is well known that there is great difficulty in producing a uniform type of wine year after year. Though the raw material is apparently the same, the wine of one year differs in quality and character from the wine of the next. This is a serious difficulty; especially to those who desire to establish a characteristic and constant brand of wine. Any plan, therefore, which promises to overcome this uncertainty is worthy of thorough trial. Such a plan is the *use of pure yeasts or ferments*, the outcome of the study of fermentation made by recent investigators. These pure yeasts have now been used extensively for four years in France and other countries, and last year were tested in California, as shown elsewhere in this report.

Another very important improvement in the methods of wine-making is the *use of cooling machines or refrigerators*. Temperature-control, though not new in theory, has been applied with practical success to wine-making only within the last two or three years. In order to render clearer the theory and practice of these two improvements—the use of pure yeasts and temperature-control—a short account of the nature of fermentation is here given.

HISTORICAL.

The phenomenon of fermentation has been known from the earliest times, but it is only within the last fifty years that anything very definite has been known of its causes and its mode of action. The alchemists considered it a kind of purifying process, in which the alcohol already existing in the liquid threw off the impurities which disguised its presence. Leuwenock, in 1680, by the aid of a microscope, first discovered the presence of minute, roundish bodies in fermenting liquids. Becker in 1682 and Stahl in 1697, connecting these bodies with the phenomena of fermentation, formulated a theory very much resembling that afterward elaborated and sustained by Liebig. The vital theory of fermentation was first suggested by Cagniard-Latour, who, in 1835, stated it in this form: "The globules of yeast seem only to act upon a solution of sugar whilst they are alive; from this it is probably to be concluded that it is by some effect of their vegetation that they set free carbonic oxid and convert the solution into an alcoholic liquor." This theory received strong support from the works of Pasteur, where the vital theory is more definitely stated. Pasteur says: "The chemical act of fermentation is a phenomenon essentially correlative with a vital act, commencing and ceasing with the latter. I believe there is never an alcoholic fermentation without a simultaneous organization, development, and multiplication of yeast globules, or continued life of the globules already formed."

The so-called mechanical theory, which received the support of the famous German chemist, Liebig, is thus stated by him: "The elements of fermentable bodies are easily displaced and have weak affinities for each other; they are thus easily caused to form new groups. In order that this transformation should take place, it is only necessary that the elements should receive a sufficient mechanical impetus. This is given by the ferment. Ferments are not particular bodies, but any nitrogenous matter in process of decomposition." This theory, though practically abandoned at the present day, was accepted as late as 1879, with slight modification, by Naegeli, who thus briefly summarizes his views: "Fermentation is the transmission of the state of movement of the radicals and atoms of the different constituents of the living plasma to the fermentable matters; by this transmission the equilibrium of the molecules is disturbed, and thus they in their turn become decomposed." Liebig's theory denies altogether that fermentation is a vital phenomenon. Naegeli admits that a living organism is the initial cause, but seems to consider the progress of the fermentation as a purely chemical phenomenon, not depending on the vital processes of the organism. Pasteur's theory, on the contrary, is that fermentation and the vital functions of the accompanying organism are inseparably connected under the conditions where fermentation takes place.

There have been other theories of fermentation, which have all been easily shown to be false. The most notable of them are Schwieger's electrical theory and Berzelius's catalytic theory. Schwieger considered that the yeast cells formed a kind of electric battery, and broke up the sugar by a kind of electrolysis.

At the present time it is conceded by all investigators that every true fermentation is accompanied by a living organism which is in some way the cause of the phenomenon; the exact mode of action, however, is still in dispute. Regarding this mode of action, there are two main theories, that of Berthelot and that of Pasteur. Berthelot and Bernard maintain that the yeast cells excrete an amorphous substance which they call *zymase*, which is the real cause of fermentation, and acts as an enzym or soluble ferment independently of any action of the yeast plant itself. They have not, however, succeeded in separating this zymase, though an analogous substance has been separated from yeast cells, called sucrase or invertase, causing the inversion of cane sugar. O'Sullivan has lately shown that invertase is not excreted by healthy cells, and that the inversion of sugar takes place within the cell. It is therefore possible that the zymase of Berthelot exists in the cell, but cannot be separated, on account of its easily decomposable nature. According to Pasteur, fermentation (he is referring to alcoholic fermentation) may be defined as life without air. When a yeast is grown with free access of air it consumes oxygen, as do plants in general, in the exercise of its vital functions and does not require glucose. But when grown in a solution of glucose (grape sugar) out of contact with the air, in what Pasteur calls the anaërobic state, it attacks the glucose, breaks it up into several substances, and from it obtains the oxygen needed. The fermentative power of yeast, he says, is at its maximum when completely deprived of air, and decreases to zero when allowed full access to atmospheric oxygen. Fermentation, then, according to this view, is a phenomenon of nutrition, and a natural and essential part of the life economy of the plant.

Recent experiments have made it necessary to greatly modify Pasteur's views. It has been shown that, instead of the absence of oxygen being essential to the most perfect fermentation, the presence of oxygen under certain conditions actually increases the fermentative power of yeast. In fact, it seems probable that the presence of a certain amount of free oxygen is essential to the life of the yeast plant, even in its anaërobic or fermentative condition. A. J. Brown has lately shown that the fermentative action of yeast cells is not connected with their growth or reproduction, and that fermentation may continue in a liquid while the size and number of the yeast cells remain unaltered or diminished. These results support one of Liebig's views which was opposed by Pasteur, viz., that fermentation and the growth of yeast are not necessarily connected phenomena. Brown proposes the hypothesis that yeast cells can use oxygen in the manner of ordinary aërobic (air-growing) fungi, but that the exhibition of their fermentative functions is independent of their environment with regard to free oxygen, basing his hypothesis upon the same experiments which led Pasteur to an opposite conclusion, together with some new experiments made by himself.

The knowledge of the connection between micro-organisms and fermentation is thus of comparatively recent date, and the exact nature of this connection is still far from being thoroughly understood. On the other hand, the nature of the chemical changes which take place during alcoholic fermentation was investigated and very well explained by Lavoisier at the end of the last century. He showed that the sugar contained in the fermenting liquid was broken up into nearly equal parts of alcohol and carbonic acid gas. Pasteur, by improved methods, found that other substances besides alcohol and carbonic acid are produced, and gave the following proportions:

Alcohol	48.37%
Carbonic acid	46.57
Glycerine	3.22
Succinic acid	.61
Loss	1.23
Grape sugar	100.00%

The part put down as "loss" was supposed to be consumed by the yeast. This formula, though substantially correct for a pure fermentation, is subject to variation, for it has since been shown that different varieties of wine yeast will yield different proportions of alcohol. In actual practice the amount of alcohol is generally found to fall short of that indicated by Pasteur's formula. Some of the alcohol is carried off by the carbonic acid gas and by evaporation, especially in hot fermentations. If other micro-organisms besides the ordinary wine yeast are present, still more of the sugar is consumed without the production of alcohol, and other substances, such as lactic and acetic acids, are formed in the wine.

Since the investigations of Pasteur, published thirty years ago, the importance of discriminating between the fermentation caused by different yeasts has been well recognized by brewers, who have modified their methods in accordance with the facts proved by him. It is well understood by them that if a perfect fermentation is obtained the remaining part of beer-making and -keeping is comparatively simple.

This is equally true with regard to wine. There is no period in the history of a wine where its quality may be made or marred with more certainty than during the critical period of fermentation. Pasteur showed how deleterious were the effects of molds and bacteria upon the quality of a fermented liquor, and how important it was to exclude these organisms as much as possible from the murk, and to avoid the conditions favorable to their development. His studies of lactic and acetic ferments made it possible, in most cases, to avoid the injury done by these pests of fermented liquors, and aided materially in the production of sound beers and wines. He was also, perhaps, the first to suggest that even when bacteria of all kinds were absent from the fermenting liquor there were differences of quality produced, which were due to difference in the yeast itself.

It was not, however, until the investigations of C. Hansen, made some ten years ago, showed that each so-called yeast was really a mixture of numerous species, each with its own distinct characteristics, that it was possible to put brewing on an absolutely scientific basis. Previously, it was supposed that there were two kinds of brewer's yeast, top and bottom: the former a yeast which maintained itself throughout the fermenting mass and required a higher temperature, the latter a yeast which remained at the bottom and performed its functions at a lower temperature. Hansen, however. showed that each of these yeasts contained several kinds, some of which were more or less injurious to the quality of the beer. Some of them caused the beer to remain turbid; others made it bitter or gave it a disagreeable odor. Acting upon this knowledge, he devised a method for freeing the true beer yeast from all other kinds, and thus obtained a perfectly pure yeast.

When this was done, the last element of chance in beer-making was practically eliminated. From a certain kind of raw material it became possible, by means of perfect control of temperature, aëration, etc., and the exclusion of all organisms but the pure yeast, to make a perfectly definite and invariable product. This use of pure yeast in breweries has become widespread in Europe, and ten years of use have proved it an unqualified success.

On account of certain peculiarities in the conditions of wine-making, there have been greater difficulties in the application of Hansen's principles to this industry, and it is only within the last four years that it has been attempted. The impossibility of sterilizing the grapes was at first thought to be an insuperable objection to the use of pure yeast, but experience has shown that though injurious ferments cannot be entirely excluded, their action can be reduced to an inconsiderable minimum.

Marx, following the methods of Hansen, has succeeded in isolating and studying over fifty species (?) of wine ferments. These, however, are many of them doubtless only varieties of the ordinary *Saccharomyces ellipsoideus*, or wine yeast, for as great differences have been found between different selected races of the same species as between these so-called species. Rommier, in 1889, was perhaps the first to apply the facts learned about selected ferments to actual wine-making. He crushed a quantity of a certain grape, and fermented different parts of it with different cultivated varieties of *S. ellipsoideus*. Each resulting wine he found differing from the others in flavor and bouquet. Later in the year, Martinand made experiments in the same direction. He fermented a must, not like Rommier with pure cultures, but with yeasts taken from different sources. He took one from a spontaneous fermentation of cherries, one from a wine of Burgundy, one of Champagne, and several others. He found in each case that he obtained wines suggesting those from which the yeast had been obtained. After this, Rommier made some still more convincing experiments. He took an artificial must containing sugar and the necessary salts, and fermented different portions of it with yeasts taken from different wines. He then distilled the wines and obtained brandies of very distinct aromas and of different intoxicating powers, though the alcoholic strength was the same in all cases. Jacquemin has made the latest experiments in this line. Some of his first experiments were with ordinary beer wort. By the addition of tartaric acid and fermentation with the appropriate yeast, he claims to have succeeded in producing wines having distinctly the character of Bordeaux, Burgundy, Champagne, etc.

PURE AND SELECTED YEASTS.

Yeasts, as is well known, are species of fungus and consist of minute roundish cells so small that it would take 500,000,000,000 of them to fill a vessel one inch cube. These cells produce by budding, and when growing in an acid, saccharine fluid, such as beer wort or grape must, produce the phenomenon of fermentation, and are therefore often known as *ferments*. Yeast as usually seen is a cloudy, frothy liquid, which, when examined under the microscope, shows the roundish, unicellular ferments floating in the liquid, either singly or in clusters of two or three. Most of the yeasts used in the manufacture of beer, and all, until late years, of the yeasts used by wine-makers, consist not of one but of several varieties or species of ferments.

Some of these varieties are useful in varying degrees and some are harmful, and the great service which Hansen has done to the brewing industry, and indirectly to wine-making, is to have made a thorough study of these ferments and thereby settled which are harmful and which beneficial, and also to have chosen and separated out the best varieties. These varieties are now produced in large quantities and sent all over Europe, where they are known as Hansen's No. 1 and Hansen's No. 2. One is especially useful for the production of export beer and the other of beer for quick consumption.

The ferment of beer is known to botanists (for yeast is a plant) by the name of *Saccharomyces cerevisiæ*. Wine yeast resembles it closely in form, but differs notably in the quality of its products. It is known as *Saccharomyces ellipsoideus*.

The name *Saccharomyces ellipsoideus* is applied to wine yeast in general, being the name of the species. But, just as there are innumerable varieties of the species *Vitis vinifera*, or European grape, so there are dozens of varieties of wine yeast, or hundreds if we are to believe Marx and other investigators, and it is reasonable to suppose that some of these, if not harmful, are at least less useful than others.

Given the same amount of care, skill, and good luck, the quality of a wine is generally supposed to depend on two things, viz., the quality of the grape and the location of the vineyard. However, we must now add another factor—the variety and purity of the yeast. The investigations and experiments of Reitsch, Martinand, Jacquemin, and others leave no doubt of the great influence of the use of certain kinds of yeast on the quality of the resulting wine. It may be said to have been distinctly proven that by the use of pure and selected yeasts wines can be greatly improved in clearness, alcoholic strength, cleanness of taste, and in quality generally. The further claim of the most ardent advocates of pure yeasts, that by the use of appropriate kinds, any character, as for instance that of "Vin de Bordeaux," Champagne, Burgundy, etc., can be produced with a neutral grape, may be considered as yet problematic. However this may be, the use of Jacquemin's pure, selected yeasts is an assured success, for whereas in 1891 only a few wine-makers experimented with them, in 1894 thousands of wine-makers all over France used them on an industrial scale.

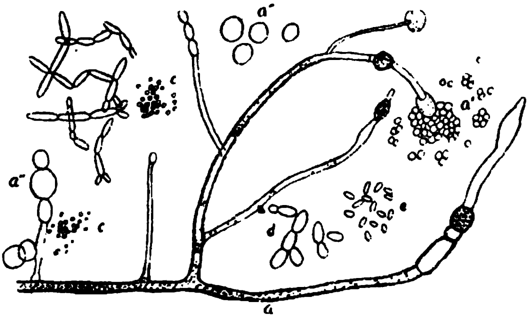

Plate I.

a, *a'*, *a''*. Various forms of a mold, (*Mucor*).
c, *d*, *e*. Various forms of yeasts, molds, and bacteria.

Jacquemin has established a laboratory, which he calls "L'Institut La Claire," in the Jura Mountains of eastern France, at an altitude of more than 3,000 feet. Here, in an atmosphere free from germs, he selects the yeasts of all the finest vintages of France and other countries, frees them from all foreign and injurious organisms, and finally cultivates them in a perfectly pure state, and sends them in large quantities all over France and to other vine-growing countries. He supplies the special ferment of Sauterne, of Chianti, and of Johannisberg. Ferments can be obtained from him which will produce the maximum amount of alcohol from a given amount of sugar; ferments for hot countries, for cold countries; ferments for cider, for perry, for honey wine—all supposed to differ in some way and to be appropriate to different uses.

Whether all that is claimed for these yeasts is true or not, they are all certainly pure, and, as such, are of the greatest value in the production of good, sound wine.

Many French wine-makers consider that by the use of these pure yeasts they have improved their product by from 10% to 50%. This can be readily credited when we consider the ordinary process of wine-making.

When the grapes are brought to the winery the skins and, still more,

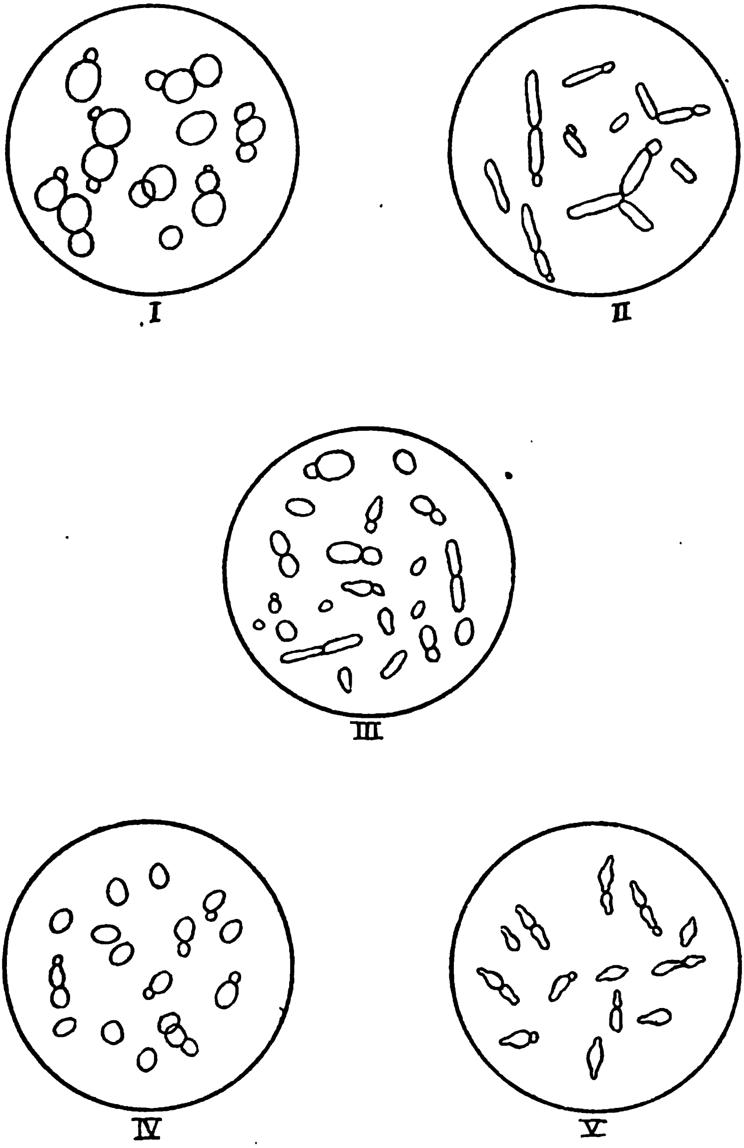

PLATE II.

I. *Saccharomyces cerevisiæ* (beer yeast).
II. *Saccharomyces pastorianus* (injurious yeast).
III. Mixture of forms found in first fermentation of a California wine.
IV. *Saccharomyces ellipsoideus* (wine yeast).
V. *Saccharomyces apiculatus.*

the stems, are covered with the spores of a multitude of ferments, molds, and bacteria, all of which enter into the race for precedence—"fair field and no favor." The race is to the strong, and the strong is the organism most suited to the conditions, but not necessarily most suited to the end in view, viz., the production of a thorough alcoholic fermentation. The above figure shows some of the many forms of micro-organisms found upon the skin of a Muscat grape from Fresno. Fig. I, Plate II, shows the appearance of a pure culture of beer yeast, and Fig. II of one of the injurious yeasts found in ordinary beer fermentations. Fig. III represents an ordinary California yeast, showing the mixture of forms that almost always occur in the early stages of fermentation. The forms shown are all yeasts or molds; the bacteria do not develop in appreciable quantities till later. Fig. IV was drawn from a pure yeast from Algeria, and shows the comparative constancy of form of a pure culture, the differences of size simply indicating differences of age. All these figures are magnified about 1,000 diameters, and consequently represent the cells 1,000,000,000 times larger than they actually are. Fig. V is *Saccharomyces apiculatus*, found commonly on unripe grapes and very acid fruits, such as gooseberries and red-currants.

As a rule the first fermentation is caused principally by the *Saccharomyces apiculatus*, a small alcoholic ferment which does no great harm except that it uses up more sugar in the production of a certain amount of alcohol than does the proper wine ferment. The apiculate yeast, being paralyzed by 2% or 3% of alcohol, soon gives way to the genuine wine yeast, which, in the most favorable cases, carries on the fermentation to dryness. In the meantime, however, the molds and bacteria have been developing, and, if anything happens to check the action of the wine yeast, they take possession and give us various varieties of milk-sour, mousy, and pricked wines.

All these organisms have two well-marked forms, which may be called the active and the inactive. When in the former state they commence to operate the moment they come in contact with the must; when in the latter they do not commence active work for hours and sometimes days after being placed in the liquid. Most of the yeasts, molds, and bacteria exist on grapes in the resting-spore or inactive state, as we see by the length of time which the first crush of grapes takes in starting to ferment. Now, the practical application of the method of fermenting with pure yeasts depends on the fact that they are put into the must in fully active condition. In this way they take complete possession of the fermenting mass before the "wild yeasts" and injurious organisms have awakened from their comatose state. We thus obtain a good, clean fermentation, and avoid the production of those unpleasant odors and tastes which the undesirable organisms that are present usually communicate in a more or less marked degree.

ORIGIN OF YEAST.

Exactly what the true wine yeast (*Saccharomyces ellipsoideus*) is, or where it comes from, has not yet been determined. It seems probable, according to the latest investigations, that it is an imperfect form of some of the higher fungi, either of a mold or of one of the *pyrenomycetes*. All that we know certainly of its origin is that the spores, together with the spores of many other organisms, are found upon the outside of ripe grapes. It has been proved that the spores of the apiculate yeast (*Saccharomyces apiculatus*) pass the winter in the soil, but where or in what form the ordinary wine yeast hibernates is not known.

Among the organisms found on the surface of the grape, one of the most plentiful is the *Mycoderma vini*, or "wine flowers." This ferment develops during fermentation, together with the yeast, though its presence is not perceptible under ordinary conditions until fermentation is almost over and the yeast sinks to the bottom. The "wine flowers" then manifests itself by forming a veil on the surface of the wine.

There are various yeasts, pseudo-yeasts (*Torulæ*), and molds which consume or break up the sugar with the production of very small quantities of alcohol. The sugar thus consumed is therefore lost. The loss from this cause is generally at least 10%, and often as much as 15% or 20%; that is, a must containing enough sugar to give, according to Pasteur's formula, 13% of alcohol, will give from 10% to 12% only. This might, at first sight, be considered an advantage in the production of light, dry wines, though there is a loss of raw material. But the action of these organisms is not confined to the destruction of the sugar; besides this, their products of elimination have a deleterious effect on the quality of the wine, and less wasteful methods can be adopted for reducing the alcoholic contents.

Unripe grapes have few or no yeast spores adhering to them. The micro-organisms found on unripe grapes are principally molds; later, as the grapes ripen, the apiculate yeast (*S. apiculatus*) appears, and at complete maturity the true wine yeast (*S. ellipsoideus*) is found. The molds, apiculate yeast, and spores of bacteria occur also on the perfectly ripe fruit.

All these organisms decompose and eliminate the sugar to a greater or less extent, but the products into which the sugar is changed vary greatly for each. The apiculate yeast, for instance, produces less alcohol than wine yeast from the same amount of sugar, while the amount of alcohol yielded by the action of molds and bacteria is inconsiderable. The amounts of glycerine, succinic acid, and the quantity and kind of the various acids and ethers on which the quality of the wine so much depends, vary in an even greater degree, not only according to whether molds, bacteria, or yeast are present, but also according to the particular variety or race of yeast which predominates. It is on these facts that the method of the amelioration of wines by means of races of yeasts, originating in the famous vintages of the Medoc and Burgundy districts, depends. The spores of the true wine yeast are much less numerous, even on ripe grapes, than those of other micro-organisms. This is not due to the absence of spores of *S. ellipsoideus* in the air, but to the fact that the surface of grapes, especially when unripe, does not present the conditions favorable to the growth or existence of wine yeast.

The scarcity of yeast germs on the grapes is well illustrated by the length of time which the first vat of grapes of the vintage requires to begin its fermentation. The reason why the later vats start so much more promptly is that all the utensils, chutes, vats, etc., even after an ordinary complete cleaning, retain enough yeast cells to thoroughly leaven the whole mass of grapes.

CONDITIONS OF FERMENTATION.

Leaving out of consideration, for the moment, the addition of wine yeast, it is possible, by proper attention to conditions, to make the true wine yeast predominate over all the other micro-organisms which enter into the fermenting-vat. If the grapes are strongly acid, the bacteria will have little chance to develop, as they are best suited to a neutral or slightly acid medium. A low temperature is also unfavorable to the development of bacteria and of *Mycoderma vini* (wine-flowers). The temperature most favorable to the growth of wine yeast is between 75° and 85° F. A lower temperature is more suitable to the apiculate yeast, so that if the temperature be kept below 75° F. there is danger that the elliptical yeast will not be able to overcome it. This is especially true of musts of low sugar contents, for the antiseptic power of sugar is more effective with the apiculate than with the true elliptical wine yeast. As the former exists and enters into the vat in the proportion of 100 to 1 of the latter, it will often be three or four days, when the temperature is low, before the latter obtains the ascendency. The danger in this is a slight loss of alcohol, a lowering of the character of the wine, and a difficulty in clearing it. If the temperature is too high, on the contrary, both yeasts are killed or paralyzed, and the lactic and acetic bacteria, *Mycoderma vini*, and other injurious micro-organisms take their place. There is, then, greater danger from a too high than from a too low temperature. The trouble with "stuck tanks" and the inferior quality of the wine produced by them will illustrate this.

The objections which have been urged, very properly, against the addition of bread or beer yeast, are thus easily explained. To add a variety of yeast unsuited to the purpose in view would be bad, but to add a species adapted to the conditions of bread- or beer-making would be absolutely fatal to a wine. The yeast would certainly become diseased when subjected to conditions of nutritive medium so different from those proper to it. It would form products which would give undesirable flavors and odors to the wine, and, even if healthy, would produce a liquor resembling beer as much as wine. Moreover, as these yeasts are paralyzed by a lower percentage of alcohol than is usually found in wine, they would certainly fail to produce the effect desired, viz., to ferment out the last of the sugar.

The chemical composition of the wine, not only as regards the essential ingredients of alcohol, acid, glycerine, etc., but as regards the ethers and substances on which the bouquets of various wines depend, is influenced, not only by the race of yeast employed, but also by the composition of the grapes and the conditions of temperature and aëration under which the fermentation takes place. Part of the variation due to these influences is from direct chemical changes and decomposition, caused by heat and oxygen, but even more, especially as regards the minute quantities of volatile ethers, to the state of health of the yeast. Anything which interferes with the healthy development and growth of the yeast changes its normal products of excretion, and causes it to form substances which seriously impair the quality of the wine.

If a vat of grapes be started with yeast from an already fermenting vat, care should be taken to perform the operation at the right moment. If the yeast be taken at the beginning of the fermentation, the apiculate form will predominate; if at the end, there will be a larger amount of

Mycoderma vini and the vinegar bacterium. The yeast, then, should be taken at the height of fermentation, for at that time the *S. ellipsoideus*, or true wine yeast, predominates, and is in its most active condition.

PURIFICATION AND SELECTION OF YEASTS.

The separation of one micro-organism from others can be made in a somewhat imperfect way by preserving, for several generations, those conditions of environment most favorable to the organism it is desired to propagate. For example, if a small quantity of yeast contaminated with bacteria be put in a nutritive sugar solution which has been made highly acid with tartaric acid, the yeast will develop freely, and the bacteria with difficulty or not at all. If, now, another fermentation be started from this one in a similar solution, the relative number of bacteria will be still further decreased. If this operation be continued several times more, most kinds of bacteria will be completely eliminated, and the yeast obtained comparatively pure. Other micro-organisms may be gradually eliminated by similar series of cultures maintained at a temperature more favorable to the yeast than to the organism it is desired to get rid of. This shows the importance of constant endeavor to maintain during fermentation all the conditions of temperature, must-composition, etc., most favorable to the yeast. In this way many of the injurious ferments are destroyed or kept within innocuous limits, and fairly pure fermentations obtained.

Late experiments tend to show that fluorid of ammonium can be used successfully in the purification of yeast. The yeast is first "trained"; that is, it is cultivated through a series of musts containing gradually increasing quantities of fluorid of ammonium until it is rendered capable of existing in liquids containing an amount of the fluorid insupportable to most other micro-organisms. In this way the sugar in solutions may be made to produce as much as 2% more alcohol than when fermented in the ordinary way, on account of the absence of those ferments which consume the sugar without a corresponding production of alcohol. This method is said to have been used successfully in the fermentation of murks for distillation.

The method of purification and selection which is used at present for practical purposes is that invented by Hansen. Without describing the minutiæ of the process, it is sufficient to say that it consists essentially in the isolation of a single yeast cell. This single cell is placed in an absolutely sterile nutritive solution, where it reproduces and increases until a yeast is obtained of which every cell is a lineal descendant of the single cell first chosen. Experiments are then made with this yeast to determine its characteristics, such as its optimum temperature, the amount of alcohol it will produce, the quality of wine or beer which it will make. In this way many different yeasts are obtained, each the product of a single cell, and each having different characteristics. Those most suitable to the object in view are preserved and can be propagated indefinitely. The original or mother cell is taken, of course, preferably from the best beers or wines, in order to increase the chance of obtaining a suitable yeast.

ACIDITY.

The acidity of wine is due partially to free tartaric and malic acids, but principally to bi-tartrate of potash. In unripe grapes the quantity of free tartaric acid is very high, and gradually decreases as they ripen. When grapes pass the point of complete maturity, the decrease of acidity generally continues, so that overripe grapes often contain less than the desired amount.

The use of plaster (gypsum) to augment the acidity of musts in France was efficacious in preventing the action of bacteria in wine. Since the suppression of the use of plaster for this purpose, bacterial troubles of wine have become much more common in France. Picking the grapes before they have reached maturity, when they contain larger amounts of malic and tartaric acids, or the addition of half-ripe grapes to grapes low in acid, has been found perfectly successful as far as concerns the protection of the wine from bacteria and from "sticking," or arrest of fermentation. It cannot, however, be recommended, even for low-grade wine, for the greenness and harshness of the wine thus made is very objectionable, and the production of fine wines is absolutely impossible by this means. The addition of tartaric acid to supplement the acidity of overripe grapes has been extensively practiced of late years in southern France. When done correctly, this addition is satisfactory in many cases, though in practice it has been found very expensive and often unreliable. The difficulty of ascertaining the exact acidity of his must and the correct amount of acid to be added is seriously in the way of the use of this method by the ordinary wine-maker. A sufficiently close approximation of the sugar contents of a must is easily accomplished by means of a saccharometer or specific gravity spindle, but all the instruments in use by wine-makers for the determination of acidity are very unreliable.

The principal use of high acidity in fermentation is not aid given to the alcoholic yeast, but prevention of the growth of bacteria. As a low temperature has exactly the same effect, and as it can be controlled with more certainty with the instruments available to the ordinary wine-maker, the use of cooling devices and probably of coolers or refrigerators is much to be preferred to the addition of tartaric acid.

The addition of tartaric acid is also very much more expensive, for, to raise the acidity of the must 0.05% would cost more than the cooling, and would hardly be enough to have any perceptible effect on the fermentation, though this is the proportion usually used in southern France. To raise the must 0.2% would cost at least $8 per 1,000 gallons, which for ordinary wines would be a serious expense. The addition of so much free tartaric acid would also be likely to give a sharp and harsh acidity to the wine.

The efficacy of low temperatures for this purpose is well exemplified by many of the fermentations of Tulare grapes made at this station. Grapes containing over 24% of sugar and less than 0.3% of total acidity (expressed as tartaric acid) have fermented through thoroughly, and without the slightest sign of the action of injurious ferments or bacteria. This is due to the smallness of the vats used and the cool and even climate of Berkeley, which have kept the fermenting mass from rising to a dangerous degree of temperature.

NITROGEN.

The presence of certain soluble nitrogenous matters is indispensable to the development of yeast. These usually occur in sufficient quantity in normal grape musts, in the form of proteid substances and amids. The amids are almost completely eliminated from the must by fermentation, and only traces are found in the wine. This has suggested the use of ammonium phosphate as an aid to fermentation. Experiments by Martinand seem to show that this salt is of use in cool fermentation, giving the yeast increased vigor, and enabling it to use up all the sugar in a must which would otherwise have remained sweet for a long time at low temperatures. The addition of peptone has been tried with somewhat similar results. At high temperatures these additions seem to have no effect, or, as in the case of peptone, are harmful on account of the aid given to the development of bacteria.

AERATION.

Aëration of the must or incompletely fermented wine has been practiced extensively in various ways. Its influence on yeast in a dormant state as it exists on the surface of grapes, or in the lees of fermented wine, is very marked. If yeast in a dormant or spore state be brought into a must which has been boiled or otherwise deprived of its dissolved free oxygen, it will fail to develop. As soon as the must is aërated and thus filled with oxygen, fermentation commences. As a rule, a must is aërated sufficiently during the process of crushing, but often a "stuck fermentation" can be revived by a thorough aëration. The usual methods of doing this affect the wine in two ways: they fill the wine with oxygen, and at the same time cool it. The lowering of temperature is of great benefit, though it is not always perceptible, for the experiments of Muntz and Rosséau show that it is almost always neutralized by the heat developed by the increased fermentation consequent on the addition of oxygen. Too much aëration of the fermenting liquid should be avoided, for it changes and precipitates the color and decreases the natural aroma of the grape. There is also a loss of alcohol by evaporation, which in some cases is very noticeable. But aëration of the must before fermentation is beneficial in another way. It renders insoluble and precipitates some of the albuminoid matters of the must, thus rendering the wine less liable to the attacks of bacteria, and more apt to clear rapidly.

INFLUENCE OF TEMPERATURE.

The deleterious effect of high temperature in the fermentation of red wines was well shown in the series of experiments made by Prof. Hilgard, and published in the Viticultural Report of this station in 1886. Judging, however, by the lack of effort made to regulate temperature in the vats of wineries, the serious import of these investigations is not yet thoroughly appreciated in California. To the undue elevation of temperature which takes place in the majority of cases all over California is to be ascribed nine tenths of the trouble to which our wines are subject.

Alcoholic fermentation—that is, the transformation of grape sugar into alcohol and carbonic acid under the influence of yeast—is a phenomenon of combustion, and is accompanied by the evolution of a definite amount of heat. Berthelot has shown that 180 grams of grape sugar in being transformed into alcohol and carbonic acid produce 71,000 calories. That is to say, if a must containing 20% of sugar be fermented dry, it will give out enough heat to raise its temperature 128° F., if all the heat were retained. Of course, this result is practically impossible, and does not occur, because under all circumstances the greater part of the heat is dissipated by radiation and the escape of the carbonic acid. Enough, however, is generally retained under the conditions of wine-making in California to raise the wine to a dangerously high temperature. The temperature, therefore, of the fermenting mass is equal to that of the grapes at crushing, plus that due to the heat evolved by the fermentation, and minus that lost by the radiation and evaporation. This shows the importance of the initial temperature of fermentation.

In every fermentation of wine there is generally a loss of about 1.5% of alcohol. That is to say, the alcohol produced, instead of being 48.5% of the sugar consumed, is only 47%. If the temperature of the fermenting mass is high, this loss may reach 3%. This is due, doubtless, to a great extent, to the simple evaporation which is favored by the high temperature, but also to the presence of sugar-destroying organisms.

If the temperature of grapes when crushed is low, the fermenting-vats small, and the outside temperature not too high, the heat of combustion will not be sufficient, in general, to raise the fermenting mass to a dangerous degree. If, however, the grapes are hot when crushed, unless some cooling device be employed, the temperature of the mass will almost certainly rise to a point which is dangerous and generally fatal to the yeast. Unless the grapes are very low in sugar-contents this point is reached before the wine is dry. The death of the yeast leaves the field open to the action of various kinds of bacteria, which are not injured by these high temperatures, and which live at the expense of the sugar remaining in the "stuck" wine. This is the starting-point for most of the diseases of wine. This "stuck" wine soon becomes the prey of lactic, acetic, tartaric, and butyric fermentations caused by bacteria, which form products giving mousy, sweet-sour, milk-sour tastes, and cause the wine to become flat, turbid, and impossible to clear. Though the vitality of the yeast is not destroyed at temperatures between 90° and 100° F., and under ordinary conditions is not killed at temperatures much below 110° F., for perfect assurance of a clean fermentation and good quality the temperature should never exceed 90° F. There are two main reasons for this: In the first place, though yeast cells are not killed at 95° F., this is not their optimum temperature, as it is approximately that of many kinds of bacteria. Thus, though the yeast is not killed, and may ferment the wine dry, it is partially paralyzed and the bacteria are able to develop side by side with it and leave their products of excretion to injure the aroma, flavor, and clearing quality of the wine, besides being a constant menace to its future health. In the second place, though the yeast is not killed, it is left in a diseased condition. The quality of a wine fermented at a high temperature is injured, not only by the flavors due to the presence of bacteria, but to the abnormal products of the diseased yeast. The high temperature, though it may not be sufficient to kill the yeast, injures its vitality and changes its form, as can be well seen by a microscopic examination. Yeast thus injured excretes substances different from those excreted in its healthy and normal state, and which have a deleterious effect on the taste of the wine. According to L. Roos,* the "sweet-sour" wines so common in hot countries are the effect of this diseased condition of the yeast. The difficulty of refermenting these wines is due, according to this author, to the presence of enough of the products of the diseased yeast to render the wine sterile to healthy yeast. This condition is too common in California to need more extended description. The obvious remedy is to crush the grapes only when they are cool. In the early morning the temperature of the grapes is always lower than that of the air, even in warm seasons being generally below 65° F., and often much lower. As the sun appears, however, the average temperature of the grapes rises more rapidly than that of the air. In the middle of the day the temperature of the grapes is generally from 5° to 10° higher than that of the air. This means that when they enter the vat they will often exceed 90°. They thus start with a temperature higher than the optimum of alcoholic fermentation, and one very favorable to bacterial life. This insures a rapid increase of all the bacterial germs before the yeast germs have become active.

The rise of temperature during fermentation is, under the conditions usually existing in California, about 30° F.; that is to say, if the grapes are crushed at 60°, the temperature of the vat will rise to 90°. This is a very favorable view, for only too often, on account of the heat of the fermenting-room and the large size of the vats, the rise is much greater. If the grapes enter the vat at 70°, therefore the ordinary rise will bring them to a temperature injurious to the life of the yeast. If the initial temperature is greater than this, the corresponding rise is less, on account of the diminished activity or paralysis of the yeast and consequent cessation of the evolution of heat. The only difference will be that a grape which, if started at 70° F., would "stick" with 2% of sugar, will, if started at 80°, "stick" with 6% or 8%. If the grapes which are picked during the heat of the day are left in the boxes all night without being piled up, they will generally be cool enough in the morning. This method, however, is not always practicable on large vineyards, and even though the grapes are crushed cool, the temperature will often rise to a dangerous height if the fermenting-room is warm and the vats large. The use, then, of some cooling device seems to be the only sure and reliable method applicable to all conditions.

REFRIGERATORS, OR COOLING MACHINES.

The wine-makers of southern France and Algeria, who are confronted by the same difficulties as those which cause so much trouble and loss in California, have, after several years of trial and experience, reduced the method of cooling to a perfectly practical basis. The method is so successful and profitable that it has been adopted by a very large number of Algerian wine-makers, and seems destined to become universal there.

The use of a cooling coil placed in the vat, after the method used by brewers, has been tried, but with only partial success, on account of the hindrance to the free circulation of the wine, due to the cap of red wines. As it is in the thick cap where the highest temperature is reached, and where the most damage is caused, this method is altogether inefficient for fermentation of red wines. For white wines the method would be good but for the trouble and expense of applying it to wine in casks. Attempts have been made to utilize the cooling properties of compressed air and carbonic acid, but without success.

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* Bulletin du Ministère de l'Agriculture; Paris, 1895.

M. Toutée's metallic fermenting-vats are a step in advance. They are made of metal (on account of its value as a heat conductor), covered with some substance to protect it from the action of the acids in the wine. The vat is covered exteriorly with cloth, which is kept constantly wet. The evaporation from this cloth is the source of the cooling, and the vats are preferably exposed to the wind in order to increase the evaporation. This method gives perfect satisfaction in the fermenting of white wines, but with red wines the imperfect circulation of the wine, which rendered the use of internal coils inadequate, reduces very much its efficiency. The question of expense also makes it inapplicable to most cases, for it involves the substitution of new vats throughout the cellar. Instead of cooling the wine within the vat, attempts have been made to cool the wine outside and return it to the vat. Drawing the wine from the bottom and pumping it over on to the cap in a spray, and allowing the wine to run over a wide surface in a thin sheet exposed to a strong current of air, are some of the methods tried. The great objection to these methods is that they expose the wine too much to the air, injuring it by the evaporation of the alcohol and by liability to acetification. The cooling machines, or refrigerators, which are used extensively in Algeria now, are all made on one of two principles. One is essentially that of the water-bath, or "bain-marie." The wine is run into a receptacle, which is surrounded by a bath of cold water. It is left there until sufficiently cool, and then pumped back into the fermenting-vat. This method is too slow in operation for large cellars, though it might be useful where but little wine is made. The other principle, employing a cooling apparatus, which allows of continuous action, and is the one most successfully used, consists of a long tube, either straight or coiled, through which the wine is pumped, and which is cooled on the outside by water alone or by water and a current of air. Some modification of the ammonia coolers in use for cold storage and dairy purposes, would probably be the most efficacious that could be devised for large establishments where the requisite power is available, and where the large initial expense could be afforded.

During the vintage of 1894 in Algeria, M. Pirodon* treated over 130,000 gallons of wine with a single cooling machine. By its aid he deprived the fermenting wine of from 7 to 10 calories of heat; that is, on the average, he reduced the temperature about 15° F. The vintage lasted forty-four days, and the apparatus was used only at night, between the hours of 11 P. M. and sunrise the next morning. It consisted of twenty tubes, each 13 feet in length and nearly 2 inches in diameter, and had a capacity of a little over 500 gallons per hour. The heat lost by the wine was about equal to that gained by the water, the wine losing a little more on account of the cooling caused by the evaporation of the water on the pipes. No figures are given as to the cost of operation, but it is said to be very small.

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*See Bulletin Agricole de l'Algérie et de la Tunisie; 15 Juillet, 1895.

The practical and economic use of a cooling machine is thus demonstrated wherever a sufficient quantity of cool water is available. M. Pirodon's experience, however, shows more than this. On account of scarcity of water he was obliged to content himself with 10,000 gallons of water, collected before the vintage and used for the whole operation. In order to cool the water after using, he constructed a shallow reservoir, divided into four compartments, having a total exposed surface of about 800 square feet. Three of these compartments were filled with water to the depth of 8 inches. The other was left empty to receive the warm water coming from the machine. The three compartments held about 4,000 gallons, the other 6,000 gallons being kept in a tank to replace the water lost by evaporation. The warm water cooled in from two to four hours, according to the weather. When there was a dry wind the cooling was very rapid, and the water sank to several degrees below the temperature of the air. These results were obtained in a locality where the weather is usually very hot and moist; in a drier atmosphere the results would be even more striking. A more effective means of cooling the water after using, but one requiring a more expensive installation, is the "cheminée climagène" of M. Dessolliers. The essential parts of its construction are such that the water runs over a mass of hollow bricks exposed to a strong current of air. The bricks might be replaced by fagots of vine canes or similar material.

EXPERIMENTS WITH PURE AND SELECTED YEASTS.

Experiments with pure and selected yeasts were first made at this station in 1893 with some Johannisberg yeast brought directly from Germany by Mr. A. P. Hayne. Other experiments were made at the same time with *Botrytis cinerea*, the fungus known as "noble mold" (*Edelfäule* of the Germans and *Pourriture noble* of the French). For an account of this fungus and how to distinguish it from other molds, see page 451. More extended experiments were made during the season of 1895, with yeasts imported from M. Jacquemin of the Institut La Claire. The following notes include the results of experiments made in 1893 at the Station, of those made in 1895 at the cellars of wine-makers, and of the more extended experiments made at the Station in the same year. The analyses were all made by Mr. G. E. Colby.

RHINE-WINE YEAST AND BOTRYTIS CINEREA, OR NOBLE MOLD.

Experiment I. The grape used in this experiment was:

No. 1912, *Verdal*, from Tulare. Received October 6, 1893, in fairly good condition, just a trifle bruised, but no mold. The must showed 18.8% of solid contents by spindle and 0.75% of acid. The must was divided into three equal lots and fermented as follows:

No. 1912, ordinary fermentation;

No. 1912*a*, fermented with the addition of Rhine-wine yeast imported from Germany;

No. 1912*b*, fermented with the addition of some grapes which were covered with the spores of *Botrytis cinerea*.

The temperature of the must at crushing was 69° F., and the maximum, of 81° for No. 1912 and No. 1912*b*, and of 77° F. for No. 1912*a*, was reached on the second day. The wine fermented with German yeast progressed slowly and was not dry until the eighth day. The other two fermented more quickly, and were dry on the fourth day.

At three weeks they were all nearly clear, and were racked for the second time and taken to the cellar. At four months they were all tasted, with the following result:

No. 1912 (ordinary fermentation)—Bright, clean-tasting, no bouquet and little flavor, full acid.

No. 1912*a* (with German yeast)—Bright, clean-tasting, has a slight bouquet, and is smoother and more agreeable than No. 1912.

No. 1912*b* (with *Botrytis cinerea*)—Bright, clean-tasting, no bouquet and little flavor, full but rather green acid, not differing materially from No. 1912.

At eight months the wines showed about the same relative character. At ten months the normally fermented wine was a little more advanced than the others. The lees of all were examined under the microscope, and found to be perfectly sound.

At sixteen months there was little difference between the three samples, except that No. 1912*a* and No. 1912*b* (the treated wines) showed a little more character than the *witness* sample, but No. 1912*a*, the wine made with German yeast, was a little less advanced. Three months later all the wines were bottled. At two years and nine months all three were perfectly bright and with very little and well-settled deposit. They were light, clean-tasting wines of little character, but vinous and agreeable. There was little difference in taste, but No. 1912*a* had a fair bouquet, which was lacking in the others.

This experiment indicates the value of Rhine-wine ferments in moderating the violence of fermentation and increasing the bouquet in light musts. They also show that the presence of *Botrytis cinerea* is not harmful in the fermenting-vat. It does not seem to have any beneficial effect, but at the same time does not injure the flavor of the wine, as most other molds do. This is a point worthy of notice, as many tons of grapes were rejected in Napa Valley during the vintage of 1893 on account of the presence of this mold. That even grapes which are badly attacked by this mold are not rendered unfit for wine-making is well illustrated by the following experiment:

BOTRYTIS CINEREA.

Experiment II. No. 1929. Grapes very moldy, from *Botrytis cinerea*; from St. Helena, Napa County. The grapes when received were completely invaded by the mold, and looked like a mass of decayed grapes, stems, and mold, without a single sound berry. The mold was examined, and found to be *Botrytis cinerea*. There was no disagreeable moldy smell to the grapes, as there would have been had the mold been the common *Penicillium glaucum* (common blue mold). The must was pressed out of the grapes as they were, and fermented as white wine. It showed 27.6% of solid contents by spindle and 0.98% of acid. The temperature of the must at crushing was 68° F., and the maximum, reached the third day, was 74°. The must fermented very slowly, and at two months was still a little sweet, but bright and sound. Six weeks later it was still bright, a little sweet, quite sound, sharp-tasting on account of its high acidity and dissolved carbonic gas, but quite clean-tasting and without any taste of mold. At seven months it was bright and sound, clean-tasting and with very little sweetness left, of marked aroma, and still charged with carbonic gas. Three months later it had changed little; it had the character of a wine made from concentrated must.

At sixteen months it was in good order and perfectly dry; it was not delicate, but sound, clean-tasting, fresh, and with good acid. Two months later it was bottled. In bottle it went through a slight fermentation, and when next examined at two years and four months it was a bright, sparkling wine, but with a distinct Sherry taste. As an experiment, it was slightly sweetened and fortified, and left loosely corked. Five months later it had developed into a very good Sherry of full aroma, clean taste, and marked character; its only defects being somewhat high acid and rather too much of the "rancio" taste.

The conclusion from these experiments is, that if the grapes are only slightly attacked by the Botrytis they may be allowed to enter the fermenting-vat with the sound grapes; if badly attacked, they had better be used separately, and probably will be found useful for Sherry-making. The following experiment is confirmatory of the above:

Experiment III. No. 1982, *Verdal* (*Napoleon*), from Tulare. Received October 25, 1893. The grapes were in good condition, and the must showed 19.3% of solid contents by spindle and 0.58% of acid. The must was divided into two lots: No. 1982, fermented normally, and No. 1982*a*, fermented with the addition of 1 gallon of must from No. 1929 to 11 gallons of the Verdal must. The must added was from the grapes from Napa, which were so badly affected by *Botrytis cinerea*. The two fermentations were perfectly similar, both as regards temperature and duration. There was no perceptible difference in the wines until they were about a year old, when the Botrytis-infected wine had slightly more flavor than the witness sample. At two years and nine months the wines had been in bottle for fourteen months. The untreated wine was bright, good, clean-tasting, agreeable, but neutral, and without bouquet. The wine which had received the addition of Botrytis was very similar, but was a little smoother and less fresh-tasting.

"JOHANNISBERG" YEAST.

Experiment IV. The following samples were taken for the experiment:

No. 2014, *White Vernaccia*, from Mission San José. Received October 26, 1893, in good condition. The must showed 24.8% of solid contents by spindle and 0.84% of acid.

No. 2015, *Peverella*, from Mission San José. Received October 26, 1893, in good condition. The must showed 23.1% of solid contents by spindle and 0.94% of acid.

The musts from the above two samples of grapes were blended in the ratio of 56% of White Vernaccia to 44% of Peverella. The blended must was divided into two lots—No. 2014–15, which was fermented in the ordinary way, and No. 2014–15*a*, which was fermented with the addition of "Johannisberg" yeast. There was no perceptible difference in the fermentation of the two lots; they both attained a maximum temperature of 76°, and were dry on the ninth day. The wines were treated alike, and were both of good quality, but showed no marked difference until they were bottled at nineteen months. Seven months after bottling the wines were tasted. No. 2014–15 (normal fermentation) was bright, without deposit, much improved since bottling, and showing a little bouquet. It was smooth and more mature than No. 2014–15*a*, but a little flat. No. 2014–15*a* (German ferments) was also perfectly bright and without deposit, of distinctly higher bouquet, fresher taste, and in general of a higher quality than the witness sample. The difference of character at this time was very marked. Seven months later both wines were in good order, and had made no deposit in the bottles. The wine fermented normally was a little brownish in color, a little flat and lacking in bouquet, in general much inferior to the wine fermented with "Johannisberg" ferments, which was of a light yellowish-green, fresh and clean taste, some bouquet, and very agreeable flavor.

No. 2021. *Black Ferrara*, from Tulare. Received October 27, 1893, in good condition. The must showed 22.6% of solid contents by spindle and 0.64% of acid.

No. 2023. *Almeria*, from Tulare. Received October 27, 1893, in good condition. The must showed 19.7% of solid contents by spindle and 0.54% of acid.

The above two samples were blended in the proportion of 75% of Black Ferrara to 25% of Almeria. The must was divided into two lots, No. 2021–23, which was fermented in the ordinary way, and No. 2021–23*a*, which was fermented with the addition of German ferments. Both wines were dry on the fourth day and did not pass the temperature of 77° F. Both were treated alike, and no difference was noted until they were ten months old, when the wine fermented with German yeast was smoother and showed a little bouquet, which was quite lacking in the other. At eleven months both wines were bottled. At two years and nine months the normally fermented wine was nearly bright, but had made a considerable deposit in the bottle, was flat, tasteless, and had a disagreeable odor. The wine fermented with the addition of "Johannisberg" yeast had much less deposit, was cleaner-tasting, and though neutral was an agreeable wine, with some bouquet and flavor. As a blending wine the latter would be valuable, while the former could not be used except with the very commonest wines. This experiment is very interesting as showing the possibility of giving some quality, by the use of an appropriate selected yeast, to even the most characterless of grapes.

ANALYSES OF MUSTS AND WINES—EXPERIMENTAL FERMENTATIONS WITH YEASTS AND MOLDS IN 1893.

	Date of Picking	MUST.				WINE.			
		Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash	Alcohol. By Weight	Alcohol. By Volume	Total Acid as Tartaric, at Six Months	Body
No. 1912. Verdal, ordinary fermentation	Oct. 4, 1893	18.80	17.70	.75	.39	7.43	9.27	.53	2.6
No. 1912*a*. Verdal, with Johannisberg yeast	Oct. 4, 1893	18.80	17.70	.75	.39	7.30	9.09	.48	2.3
No. 1912*b*. Verdal, with *Botrytis cinerea*	Oct. 4, 1893	18.80	17.70	.75	.39	7.36	9.18	.56	2.3
No. 1929. Moldy grapes (Zinfandel?) from St. Helena	Oct 12, 1893	27.60	26.31	.98	.....	11.85	14.50	.96	3.8
No. 1982. Verdal (Napoleon), ordinary fermentation	Oct. 18, 1893	19.30	18.46	.58	.25	7.64	9.54	.44	2.6
No. 1982*a*. Verdal (Napoleon), with *Botrytis cinerea*	Oct. 18, 1893	19.30	18.46	.58	.25	8.34	10.42	.45	2.6
No. 2014. Vernaccia } blended	Oct. 24, 1893	24.80	23.80	.84	.32	*9.70	12.09	.67	2.8
No. 2015. Peverella	Oct. 24, 1893	23.15	21.22	.94	.23	†9.78	12.20	.71	2.4
No. 2021. Black Ferrara } blended	Oct. 26, 1893	22.60	21.63	.64	.32	.....	....	....	.....
No. 2023. Almeria	Oct. 26, 1893	19.70	19.20	.54	.41	‡8.13	10.17	.44	2.5

*No. 2014-2015, ordinary fermentation. †No. 2014-2015*a*, with Johannisberg yeast. ‡No. 2021-2023*a*, with Johannisberg yeast.

FURTHER EXPERIMENTS WITH SELECTED YEASTS.

In July, 1895, the following pure and selected yeasts were received from George Jacquemin of the "Institut La Claire," Le Locle, Doubs, France: Medoc, Burgundy, Chianti, Sauterne, Johannisberg, Algerian (for high temperatures).

A quarter-liter bottle of each was received. They were put up by Jacquemin's special method, which is guaranteed to keep them in good condition for at least six months. On September 10th a number of Sternberg flasks were filled from each bottle. Some of each of these were used to innoculate small flasks of sterilized must, and the rest kept in reserve. Needless to say, all necessary precautions were taken to avoid contamination from foreign spores. The Algerian, Burgundy, and Johannisberg yeasts fermented within two days when kept at a temperature of 77° to 82° F. The rest were then aërated, and the Bordeaux started at the end of nine days. The Sauterne and Chianti yeasts failed to develop. When the small flasks (100 c.c.) were in full fermentation the contents of each were poured into a three-liter flask of sterilized must. These three-liter flasks were then sent to various wine-makers for experiment, accompanied by the following circular explaining the method of use:

Directions for Using Pure Yeast.

(For 1,000 gallons of wine.)

1. Take four boxes (200 lbs. at least) of good, sound, freshly picked grapes. The grapes should be picked while cool. Wash them thoroughly with a stream of water. Crush them into a tub and strain off the must into a small keg.

2. Mix the contents of two flasks with the must, and allow to stand for 48 hours in a warm place (between 70° and 80° F.)

3. (*a*) For white wine: Pour the contents of the keg into the fermenting-cask, or a proportionate part into each of the casks if smaller cooperage is used, and then put in the must to be fermented.

(*b*) For red wine: Pour one sixth of the contents of the keg on to the bottom of the fermenting-vat, and then put in the rest gradually as the vat is filled, being careful to distribute it as thoroughly and equally as possible, and finally give the whole a good stirring.

4. Make a parallel experiment without using the pure yeast, under as nearly as possible similar conditions, by fermenting the same amount of the same grapes in a cask or vat of the same size. Keep the wines separate for as long a time as practicable for comparison.

CAUTION! Every utensil used in the preparation of the yeast—boxes, tubs, buckets, stirrers, etc.—must be thoroughly cleaned with boiling water immediately before use.

N. B.—It is important that all these directions should be minutely followed.

EXPERIMENTS BY WINE-MAKERS.

Fourteen samples of yeast were sent out to various wine-makers, but only seven were reported on. The results so far obtained are as follows:

Experiment I. One flask of Johannisberg yeast was sent to W. S. Keyes, Howell Mountain, St. Helena, Napa County, on October 4, 1895. The report from Mr. Hume, the cellarman, was as follows: "Two puncheons were filled on October 5th with must from Johannisberg Riesling. The must showed 24% of solid contents by the saccharometer, and a temperature of 64°. To one puncheon the yeast was added, and the other was allowed to ferment spontaneously as a witness. Fermentation in the treated puncheon was very perceptible on the evening of the following day. On the sixth day it was very active, and the temperature had risen to 85°. The saccharometer showed 7%. After this the fermentation became slower, and the temperature fell. At ten days the fermentation was very slow, and the saccharometer showed 4%, the thermometer 67° F." On June 16, 1896, samples of this wine and of the witness were received at the laboratory, and analyzed, with these results:

JOHANNISBERG RIESLING.	Alcohol.		Acid as Tartaric.	Solids.	Sugar.
	By Weight.	By Volume.			
Wine with Johannisberg yeast	9.92	12.36	.55	7.00	3.88
Wine without added yeast	12.54	15.40	.41	2.30	Dry.

The wine fermented without the addition of yeast was clear, dry, slightly astringent, clean-tasting, and of very marked aroma. The wine fermented with Johannisberg yeast was equally clear, of equal or better aroma, quite clean-tasting, and smoother than the other; it was still very sweet, and smelled slightly of sulphur. Its lees showed an abundance of yeast of rounder outline than the usual California yeast. The lees of the witness showed little yeast.

Experiment II. Two flasks of Johannisberg yeast were sent to K. Dresel, Sonoma, in October, 1895. On June 20, 1896, two samples of Traminer wine were received at the station, one fermented with yeast and one without. They were analyzed, with the following results:

TRAMINER.	Alcohol by Volume.	Acid.	Body.
With yeast	13.75	.44	2.1
Without yeast	15.00	.53	2.3

The wine fermented in the usual way was cloudy, of strong, characteristic aroma, full flavor, but not quite clean-tasting, and slightly bitter. That fermented with Johannisberg yeast differed little from the other, but was slightly more bitter. The lees of both wines, examined microscopically, showed abundance of bacteria.

Experiment III. Two flasks of Johannisberg yeast were sent to Beringer Bros., St. Helena, Napa County, on September 23, 1895. On June 19, 1896, two samples of Burger were received from the above firm; one fermented with the addition of yeast, and the other without. Analysis gave these results:

BURGER.	Alcohol by Volume.	Acid as Tartaric.	Body.
With yeast	11.50	.502	2.1
Without yeast	11.60	.577	2.3

The wine fermented in the ordinary way was cloudy, with little flavor or aroma, and with sharp, unpleasant acid. That fermented with Johannisberg yeast was nearly clear, with some aroma, clean taste, and smoother acidity than the witness. The wines examined microscopically showed very few yeast cells. The sediment of the treated wine was nearly pure, but that of the witness showed a few bacteria.

In these three experiments we have apparently two failures and one success. The reason is not far to seek, and teaches an important lesson, viz., that our yeast must be carefully chosen in accordance with the suitableness of its characteristics to the object in view, and of the conditions of environment in which we place it. The Johannisberg yeast is evidently unsuited to musts with high sugar contents, as might be expected.

In Mr. Keyes's experiment the fermentation was arrested when the must contained 12.36% of alcohol by volume and 3.88% of sugar, while the witness fermented dry with 15.4% of alcohol. At the time of analysis the treated wine was still fermenting, probably in consequence of the small amount of native yeast it contained mixed with the Johannisberg. The high amount of alcohol attained by the witness shows the power of the native yeast of eliminating large quantities of sugar and resisting the antiseptic action of alcohol. It is beyond doubt much more suited to the fermentation of such heavy musts than the Johannisberg ferment, and if such musts are to be fermented, a selected native yeast would doubtless be as good or better than any other. The "stuck" wine exhibited no sign of unsoundness, thus showing a very pure fermentation. There were no bacteria present, thus proving that the trouble was simply the inability of the yeast to break up so much sugar. The use of a yeast like this would be worthy of trial in the production of wines, such as Sherries or sweet Sauternes, in which it is intended to retain a certain amount of unfermented sugar.

In the case of Mr. Dresel's wines it is doubtful if the musts had the same amount of sugar originally. They show that the addition of pure yeast did not prevent the action of bacteria, though it might have done so in a lighter must.

In the Beringer Bros.' Burger must the Johannisberg yeast was evidently at home, and the result was an unqualified success. The must was light in sugar and body, and with full acid, and the superiority of the wine fermented with Johannisberg yeast was very marked. There was seemingly not the increase in alcohol that is claimed as a consequence of the use of pure yeasts, but in the absence of an analysis of the original musts this cannot be determined with certainty.

Experiment IV. On September 30, 1895, flasks of Burgundy and of Algerian yeasts were sent to the Swiss-Italian Colony, Asti, Sonoma County, Cal. A 3,000-gallon vat of Zinfandel was fermented with each kind, and a parallel vat without addition. The must was analyzed on October 9, 1895, and the wine on May 25, 1896, with the following results:

ZINFANDEL.	MUST.		WINE.						
	Solid Contents by Spindle	Acid as Tartaric	Alcohol by Volume	Acid as Tartaric	Tannin	Body	Sugar	Color	
A. Witness			13.00	.64	.328	3.20	.46	5VR	25.5
B. Burgundy yeast	23.91	.82	13.50	.56	.240	4.10	1.00	4VR	22.6
C. Algerian yeast	22.23	.84	13.50	.51	.240	5.70	2.24	4VR	25.2

A. Zinfandel, fermented in the usual way. Nearly dry, with high acid and astringency. Its aroma was not so good as that of B and C.

B. Zinfandel, fermented with Burgundy yeast. Nearly clear, with better aroma and less acid than A; very astringent and still sweet; mellower and cleaner-tasting than A.

C. Zinfandel, fermented with Algerian yeast. Nearly clear; best aroma of the three, but contains a good deal of sugar; a full, mellow wine, which would be of excellent quality if dry.

Experiment V. Two flasks of Burgundy yeast were sent to H. Lefranc, San José, on October 2, 1895. The following careful notes of the fermentation were taken by Mr. Lefranc:

"On October 8th, at 5 P. M., we took six cases (240 pounds) of Mataro and Grenache, gathered in the cool of the morning, carefully picked them over, and then turned on the hose and washed them thoroughly, removing all foreign or dry matter. Then we placed, say a case of grapes at a time in a steamed tub, and a man stepped in with clean rubber boots and tramped the juice out, placed the strained juice (9 gallons) in a steamed 10-gallon keg, and then added the contents of the two decanters of yeast, well blending the whole. We then placed the keg, with the bung inverted, on two scantlings over the top of a fermenting-vat. Temperature of the vat, 70° F.

"October 10th, at 2 P. M., the blend commenced to ferment out of the keg, so we placed the liquid in a half-barrel. Temperature of the liquid ('levure'), 72° F.

"October 10th, at 5 P. M., we crushed in each vat about two tons, or two loads of grapes, picked that afternoon. Before crushing I placed about three quarters of a gallon of the liquid over the bottom of the treated vat, and then, on the morning of October 11th, at 7 o'clock, we continued to fill both tanks with grapes picked the same morning, alternating a load in each vat. At the same time I added three fourths of a gallon of the liquid to each load of grapes that we crushed into the vat, until I had used up the liquid in that one vat. I then had the man practice a severe foulage, first in the tank without levure, and afterward in the vat with levure. I then tested the must in the two vats, and found 24% of sugar, and temperature 68° F. I immediately placed on a false head, and after securing the same I had about 100 gallons of freshly pressed press-wine pumped on top so as to cover the false head, as is my custom with all my tanks of fresh must.

"On Saturday afternoon, October 12th, the temperature of the 'non-levured' tank was 75° F., and of the 'levured,' 77° F. I would have judged from superficial appearances that the 'levured' vat was one day older, otherwise both were alike.

"On Monday, October 14th, I removed the false head of both vats and gave another foulage, and on Tuesday allowed both tanks to run separately into 1,000-gallon oak storage casks. These vats each gave about 1,100 gallons of wine, not including the pressings. Your dose was for 1,000 gallons.

"The grapes used for both tanks were good, sound grapes, in the following proportions: ½ Carignane, ⅓ Mataro, and ⅙ Grenache."

On November 5, 1895, samples of the wine experimented on were received from Mr. Lefranc, and analyzed, with the following results:

BLEND.	Alcohol by Volume.	Acid as Tartaric.	Solids.	Sugar.	Color.
With yeast	13.25	.54	5.10	1.68	1VR 40.00
Without yeast	13.25	.53	2.84	....	1VR 34.80

The wine fermented without the addition of yeast was clear and of good aroma, dry, and very astringent. That with yeast was also clear, but not quite dry, and with less aroma, but quite sound.

Samples of the same wine were received on December 16, 1895, and analyzed, as follows:

BLEND.	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Solids.	Color.
With yeast	13.60	.67	.282	2.95	VR 35.7
Without yeast	14.10	.52	.266	2.70	VR 33.9

The wine with added yeast was not quite clear, and was mellower than the other. Otherwise there was little difference: they were both of good flavor, color, and body, medium acid and full astringency.

Experiment VI. Two flasks of Burgundy yeast were sent to the Fountain Grove Vineyard, Santa Rosa, Sonoma County, California, on October 7, 1895. The yeast was used to ferment a vat of Mataro, according to the directions which were sent with it. Samples of the wine were tasted on May 17, 1896. The wine to which yeast had been added was smoother, fuller, but less developed, and with less bouquet than the witness. The acidity of the treated wine was smoother and more agreeable. Samples of the treated and the untreated wine were received June 15, 1896, and analyzed, as follows:

MATARO.	Alcohol by Volume.	Acid as Tartaric.	Tannin.	Solids.
With yeast	12.36	.577	.259	2.85
Without yeast	13.09	.540	.252	3.20

Both wines were examined microscopically, and found to be normal.

These three experiments with Burgundy yeast show fairly concordant results. The effect seems generally to be to make the wine rounder and smoother, but of slower development. The Burgundy yeast, like the Johannisberg, seems inferior to the native California yeast in eliminating sugar from heavy musts.

EXPERIMENTS AT THE VITICULTURAL LABORATORY AND CELLAR.

Experiment I. On September 26, 1895, a blend was made of Mourastel 36%, Grenache 33%, and Petit Bouschet 31%. The grapes were from Tulare, and were mature and in good condition. The blended grapes were divided into three lots:

No. 2424–26. Crushed and fermented in the usual way.

No. 2424–26*a*. The grapes were dipped in sulphured water, hosed off, and then crushed after allowing them to drain a short time on a screen.

As the crushed grapes were put in the vat, three liters of Algerian yeast was added gradually.

No. 2424–26*b*. Treated in the same way as No. 2424–26*a*, except that Bordeaux yeast was employed instead of Algerian.

The wine fermented in the ordinary way reached its maximum temperature of 97.5° F. on the fourth day, and was drawn off on the fifth, while still a little sweet. That with Algerian yeast reached its maximum temperature of 97° F. on the third day, and was dry on the fourth, when it was drawn off. The observations of the fermentation of the Bordeaux vat were identical with those of the Algerian. In nine days the witness was still cloudy, while the other two were nearly clear. Ten days later the witness was still cloudy, with flat taste, little aroma, and much inferior to the other two. The wine fermented with Algerian yeast was quite clear, with good aroma and clean taste. The Bordeaux was the best of the three; it had less aroma than the Algerian, but was more delicate. The latter two wines were racked and taken to the cellar at this time. The witness was left in the fermenting-room for two weeks longer, when it was racked also and taken to the cellar, though still not quite clear. At two months the witness had improved; it was clear, though not so bright as the others nor so clean-tasting, and possessed of less aroma. There was little difference between the other two, though No. 2424–26*b* (Bordeaux) was still a little more delicate. At five and a half months the witness was not so clear as the Algerian and Bordeaux, and tasted bitter. The Algerian had improved most of all, and, though differing little from the Bordeaux, showed more aroma. Four months later the Algerian was still the best of the series; it showed excellent aroma and was smoother and more agreeable than either of the others.

Experiment II. A blend was made consisting of 35% Black Prince, 15% Mission, 20% Moretto, 10% Tinta Amarella, 10% Tinta Cão, and 10% Mourisco Preto. The blended grapes, which came from the Tulare station, were divided into two lots:

No. 2448–53. Fermented in the ordinary way.

No. 2448–53*a*. Fermented with Algerian yeast. The grapes were dipped in sulphur water and washed, as in No. 2424–26*a*.

The witness attained a maximum temperature of 84° F. on the fourth day, and was pressed and fortified on the fifth. The Algerian yeast vat attained a maximum of 88° F. on the third day, and the wine was drawn off and fortified on the fourth. At six weeks both wines were clear and differed little, except that the witness had a slight taste of mousiness. On April 1st both wines were put in the heating-chamber for three months, at a temperature of 95° F. On July 18th, when the wines were nine months old, the witness was much superior to the wine fermented with Algerian yeast. It was nearly clear, of strong Port aroma and flavor, a Port of marked character, but somewhat coarse. The treated wine had much less of the Port character.

Experiment III. Nos. 2462–64 and 2462–64*a* consisted of 40% Carignane, 40% Aramon, and 20% Tinta Valdepeñas. The former was fermented with Bordeaux yeast and the latter with Algerian. The grapes were grown at the Tulare station. Somewhat less yeast was added to the Bordeaux fermentation than to the other. It attained a maximum temperature of 89.5° F. on the fourth day, when it was drawn off nearly dry. The Algerian fermentation attained a maximum temperature of

93° F. on the third day, and was drawn off very nearly dry on the fourth. Eight days later both wines were still cloudy, but the Bordeaux least so; it also had more aroma and tasted better than the Algerian. At twenty-five days from crushing they were both quite clear, and were racked off and taken to the cellar.

A month later the wines were bright; the Algerian was less advanced, of less agreeable flavor, but more marked aroma than the Bordeaux. At five months the Bordeaux was bright, very fresh and agreeable, had developed very quickly, showed good flavor and some bouquet, clean, fresh acid, and moderate astringency. The Algerian was a very good wine, tasted fuller and rounder than the Bordeaux, but had less bouquet. They were both good, clean-tasting wines, which had developed quickly. The blend would have been better with a little more of the Tinta.

Four months later the Bordeaux was in good order; it had good bouquet and was more astringent and more developed than the Algerian. The Algerian was smoother and of rather better tint than the Bordeaux. The wines differed in character, but were about equal in quality.

Experiment IV. Nos. 2472–74 and 2472–74*a* were blends of Palomino 35%, Beba 25%, and Malmsey 40%. The grapes came from the Tulare station, and were in good condition and well matured for sweet-wine purposes. No. 2472–74 was dipped and washed in the same way as in former experiments, and fermented with Algerian yeast. The other was fermented in the ordinary way. The vat with added yeast started more promptly and only attained a maximum temperature of 83.5° F., 1° lower than that attained by the witness. On the fourth day they were both fortified. At six weeks the wine fermented with Algerian yeast was clear, clean-tasting, and just sweet enough. The witness differed little, except that it was not quite so clean-tasting. At six months they were both racked for the second time, and put in the heating-chamber, at a temperature of 95°, for three months. Three weeks after taking from the heating-chamber the witness was nearly bright, of full aroma and good flavor, but bitter and still very raw. The Algerian wine was brighter, smoother, and cleaner-tasting, and it showed only the slightest bitterness, much less than the witness. It had rather less character, but was superior in every other way.

Experiment V. Nos. 2477–84 and 2477–84*a* were blends of Gros Mansenc 14%, Mondeuse 30%, St. Macaire 13%, Refosco 15%, Affenthaler 16%, and Carignane 12%. The grapes were from Mission San José and were all in good condition and mature, with the exception of the Gros Mansenc, which was a little green. The blended grapes were divided into two lots: No. 2477–84, treated as in former experiments and fermented with Burgundy yeast, and No. 2477–84*a*, fermented in the ordinary way. The treated wine attained its maximum temperature of 92.5° F. on the second day, and was drawn off on the third while still a little sweet. It was left in the fermenting-room, and was dry the next day. The witness attained its maximum of 96° F. on the third day, and was drawn off on the fourth while still a little sweet. Ten days after crushing the treated wine was dry and nearly clear; the witness was dry but cloudy. At eighteen days they were both clear, and were racked and taken to the cellar. At six weeks the treated wine was bright, of very distinct aroma and flavor, differing considerably from the witness, which, however, tasted more advanced in its development. At five months the witness was bright and in good condition, in general a good wine. The treated wine was bright, full, and round, and with rather more aroma than the witness. Four months later both wines were very good, but the treated wine still showed more character.

Experiment VI. No. 2531, Aramon, from Mission San José. Received October 16, 1896, in good condition. The grapes were very fine and well ripened, though not very sweet. The grapes were not washed, but were fermented with the addition of Algerian yeast. The maximum temperature, reached on the third day, was 93° F., and on the next day the wine was dry and was drawn off. At eleven days the wine was not quite clear, but was of good flavor, astringency, and acid. Ten days later it was still not quite clear or quite dry, but was of good flavor. At five months it was bright, of good color and aroma, full flavor, a very agreeable wine. It had developed with remarkable quickness, and was already a drinkable wine. Four months later it was still good and had developed some bouquet. It was one of the best light red wines made from grapes from Mission San José. Its color was light but sufficient, and of good tint. It had a good, agreeable acid, full astringency, and clean after-taste.

ANALYSES OF WINES MADE IN EXPERIMENTAL FERMENTATIONS WITH PURE YEASTS.

VARIETIES USED.			Date of Picking	MUST.			
				Solid Contents by Spindle	Sugar by Copper Test	Acid as Tartaric	Ash
	Experiment I.						
No. 2424.	Mourastel, from Tulare	Blended.	Sept. 24, 1895	22.10	20.60	.85	.30
No. 2425.	Grenache, from Tulare		Sept. 24, 1895	24.45	23.13	.50	.25
No. 2426.	Petit Bouschet, from Tulare		Sept. 24, 1895	22.50	20.99	.68	.27
	Experiment II.						
No. 2448.	Black Prince, from Tulare	Blended.	Sept. 28, 1895	24.10	23.42	.38	.47
No. 2449.	Mission, from Tulare		Sept. 28, 1895	24.50	23.42	.53	.44
No. 2450.	Moretto, from Tulare		Sept. 28, 1895	23.10	22.23	.83	.40
No. 2451.	Tinta Amarella, from Tulare		Sept. 28, 1895	23.90	22.31	.58	.47
No. 2452.	Tinta Cão, from Tulare		Sept. 28, 1895	23.70	21.80	.51	.45
No. 2453.	Mourisco Preto, from Tulare		Sept. 28, 1885	23.70	22.23	.50	.44
	Experiment III.						
No. 2462.	Carignane, from Tulare	Blended.	Oct. 1, 1895	21.90	21.07	.64	.40
No. 2463.	Aramon, from Tulare		Oct. 1, 1895	18.60	17.70	.75	.40
No. 2464.	Tinta Valdepeñas, from Tulare		Oct. 1, 1895	27.15	26.00	.38	.43
	Experiment IV.						
No. 2472.	Palomino, from Tulare	Blended.	Oct. 6, 1895	23.30	22.23	.35	.43
No. 2473.	Malmsey, from Tulare		Oct. 6, 1895	22.60	21.38	.38	.47
No. 2474.	Beba, from Tulare		Oct. 6, 1895	24.10	23.13	.33	.41
	Experiment V.						
No. 2477.	Carignane, from Mission San José	Blended.	Oct. 8, 1895	25.60	24.64	.90	.29
No. 2480.	Affenthaler, from Mission San José		Oct. 8, 1895	23.70	22.95	.75	.30
No. 2481.	Refosco, from Mission San José		Oct. 8, 1895	25.65	24.64	.55	.31
No. 2482.	St. Macaire, from Mission San José		Oct. 8, 1895	25.90	24.64	.81	.27
No. 2483.	Gros Mansenc, from Mis'n San José		Oct. 8, 1895	22.40	20.83	1.26	.34
No. 2484.	Mondeuse, from Mission San José		Oct. 8, 1895	23.70	22.23	.65	.26
No. 2477–84.	Blend			21.70		.75	
No. 2477–84*a*.	Blend			23.70†		.81	
	Experiment VI.						
No. 2531.*	Aramon, from Mission San José		Oct. 14, 1895	22.40	20.54	.64	.32

*Fortified. †Diluted after analysis, see record.

Analyses of Wines Made in Experimental Fermentations with Pure Yeasts—Continued.

Blends.	FERMENT USED.	WINE.					
		Alcohol.		Tannin..........	Total Acid as Tartaric.		Body..........
		By Weight..	By Volume.		At Pressing.	At Five Months..	
	Experiment I.						
No. 2424-26	Ordinary fermentation..............	8.82	11.00	.175	.59	.49	2.60
No. 2424-26*a*	Algerian yeast....................	8.82	11.00	.174	.65	.49	2.90
No. 2424-26*b*	Bordeaux yeast....................	8.82	11.00	.178	.58	.48	2.60
	Experiment II.						
*No. 2448-53	Ordinary fermentation..............	......	17.60	.126	.48	.60	2.95
*No. 2448-53*a*	Algerian yeast....................	......	17.00	.116	.56	.46	3.10
	Experiment III.						
No. 2462-64	Bordeaux yeast....................	8.45	10.50	.186	.63	.59	3.10
No. 2462-64*a*	Algerian yeast....................	8.53	10.60	.166	.60	.61	3.30
	Experiment IV.						
*No. 2472-74	Algerian yeast....................	......	18.50	......	......	.33	2.60
*No. 2472-74*a*	Ordinary fermentation..............	......	17.50	......	......	.25	2.10
	Experiment V.						
No. 2477-84	Burgundy yeast....................	8.70	10.80	.225	.88	.71	2.60
No. 2477-84*a*	Ordinary fermentation..............	8.53	10.60	.255	.75	.67	3.40
	Experiment VI.						
No. 2531	Algerian yeast....................	8.74	10.91	.209	.68	.65	2.80

* Fortified.

GENERAL CONCLUSIONS.

Amount of Alcohol Produced.—By looking at the table of analyses of the wines made at Berkeley, it may be seen that the amount of alcohol produced falls considerably below what might have been expected from the sugar contents of the musts. This is accounted for by the water which adhered to the grapes in dipping. The dipping and washing which the grapes underwent reduced the sugar contents just 2%. As the conditions of the experiments precluded the dipping of the grapes intended for witness tests, sufficient water was added to these to reduce them in the same proportion.

There is no indication of the production of a greater amount of alcohol by the pure ferments, such as is claimed for them by some European investigators. In fact, in the wines made at the cellars of wine-makers the reverse seems, at first glance, to be true. This, however, can be accounted for by the unsuitableness of the yeast employed, by the heavy musts, and by the high temperatures which obtain in most cellars, and does not in any way indicate a loss of alcohol or waste of raw material by the pure yeast. Owing to the difficulty of obtaining exact data regarding the chemical composition of the must, and of perfectly controlling the conditions in large-scale experiments, it would be unwise to draw any conclusion with regard to this part of the question without a considerable number of further trials.

Temperature of Fermentation.—In the Berkeley experiments the wines which were started with yeast commenced to ferment directly, became dry more quickly than those fermented spontaneously, and in most cases did not attain so high a temperature. Apparently, these results in some ways contradict those obtained at the vineyards. But it is to be noted, as remarked before with regard to the formation of alcohol, that the conditions of experiment are somewhat different in the two cases. At Berkeley the coolness of the atmosphere and the smallness of the vats are conducive to cool fermentation. At the vineyards the conditions almost always insure hot fermentations. In looking only at the results from the large-scale experiments, it would be natural to suppose that the addition of yeast had caused a sudden and violent fermentation which had raised the temperature above the critical point, thus causing the wine to "stick." Taking into consideration, however, the experiments at Berkeley, it seems more probable that, instead of increasing the temperature, these selected yeasts fail to produce as much heat as the natural ferments; but being less at home in the heavy musts and at the high temperatures of most Californian vintages, they are more quickly paralyzed, and thus fail to make their wines as dry as those fermented in the ordinary way. This by no means condemns them as unsuitable for our uses, but shows that, except in special cases, they cannot be used without the coöperation of some cooling device and probably the reduction of the high sugar contents of the must by some suitable means.

Improvement of the Wine.—As to the improvement of the wine by the use of pure yeast, it is to be noted that in every one of the experiments at Berkeley the wines fermented with the addition of yeast were cleaner and fresher-tasting than those allowed to ferment with whatever yeasts happened to exist on the grapes. The difference was in some cases not very marked at first, especially in the earlier experiments, where the precaution of washing the grapes was not taken. The difference in these earlier wines, however, though slight at first, increased as the wines advanced in age. The difference in the wines made in 1895, on the contrary, was in most cases very marked from the beginning. The promptness with which fermentation commenced, and the short time in which it finished, prevented the development of any large number of injurious ferments, while the rapid clearing made it possible to rack the wine early and thus remove it from the influence of what injurious micro-organisms did exist in the lees before the taste was affected.

The Burger wine, made by Beringer Bros., shows how the same result may be obtained with light musts on the ordinary industrial scale. How much of this improvement is due simply to the addition of yeast, and how much to the particular kind of yeast added, it is impossible to say at present. Doubtless a large part of it is to be accounted for by the promptness of the fermentation, precluding the development of injurious ferments, though the experiments show also that there do exist marked differences between the products of the various yeasts used.

For sweet wines the ordinary yeast spontaneously developed from the grapes themselves seems better adapted than the Algerian yeast to bring out the strong characteristics of Ports and Sherries. This is doubtless equally true of the other yeasts tried, though no direct experiments were made with them for this purpose. However, in all cases the pure yeast produced the cleanest-tasting wines, though somewhat lacking in character. When the difference is slight, as in Nos. 2448–53 and 2448–53*a*, it does not make up for the lack of character, for the heavy, somewhat coarse character and rancio flavor of sweet wines disguise a slight deficiency in cleanness of taste. Where the difference is great, however, as in Nos. 2472–74 and 2472–74*a*, the undesirable tastes of the witness make the smoother and cleaner-tasting Algerian wine more desirable, in spite of its comparative lack of character.

Summary of Conclusions.—To sum up the conclusions that may fairly be drawn from the experiments made so far, the merits of the use of pure yeast are the following:

A quicker fermentation;
A more prompt clearing;
A cleaner taste, due to the overslaughing of injurious ferments;
And probably an improvement in flavor and bouquet.

It must not be forgotten, however, that these advantages can be obtained only if a yeast appropriate to the conditions is used; and the indications are that in many cases the use of a pure California yeast will be preferable to any other. This, however, is a matter for future investigation.

FERMENTATION AT HIGH TEMPERATURES AND WITH THE ADDITION OF VARIOUS SUBSTANCES.

Among the methods recommended and tried for the prevention of defective fermentations in hot climates, additions of certain substances to the must is perhaps the most common. These additions are made on one of three principles: (1) To render the must unsuitable to the growth of injurious organisms; (2) to increase the development of the yeast by making the must more favorable to its growth, and thus overslaughing the injurious ferments; and, (3) to keep the temperature of the must below the optimum for injurious ferments, by retarding the rapid development of the yeast.

In the first category are the addition of plaster, tartaric acid, unripe grapes; in the second, the addition of ammonium phosphate, peptone; in the third, the addition of sulphurous acid, sulphites, asaprol. The experiments described below were made in order to test the relative and absolute value of these various additions. The first two experiments were made to compare the effect of defective fermentation due to high temperature in dry and in fortified wines.

FERMENTATION AT HIGH TEMPERATURES.

(*a*) *Dry Wine.*—No. 858, Pinot Chardonay, from Mission San José. The grapes were in good condition, and yielded a must containing 24.24% of sugar and 0.48% of acid. In order to test the effect of the high temperature, which often exists in cellars in the hotter portions of the State, the must was put, immediately after pressing, into a room kept at a temperature of 93°. The wine fermented through, but showed the effect of bad fermentation. The wine was treated to the usual number of rackings, but deteriorated rapidly and was soon quite spoiled.

(*b*) *Sweet Wine.*—No. 1203, Verdelho, from Fresno. (See general record, page 319.) The grapes were in excellent condition, and showed 24.1% of solid contents by spindle and 0.65% of acid. They were fermented in a hot room at a temperature varying between 91° and 98° F., in order to test the effect of high outside temperature. The must at crushing showed a temperature of 69° F. It soon rose to 89° F., and remained at 88° to 89° throughout the experiment. The must fermented strongly for six days, when it gave unmistakable evidence of being "stuck." On the eighth day the wine was still very sweet and giving but slight signs of fermentation. In order to avoid too much contact with the air, it was racked into a smaller keg. On the next day fermentation had almost stopped, and 3 pro mille of *ammonium phosphate* was added. A day later the fermentation had revived, and continued for two or three days. At the end of twenty days the wine had a suspicious taste, and the lees showed abundance of bacteria. Six days later it tasted worse, and bacteria could be found all through the wine. The wine still showed 9% of solid contents. It was fortified to 14% of alcohol. Three months later it was racked for the third time, and refortified to 18.2% of alcohol. After fortifying the second time the wine showed 7.56% of solids, of which 4.60% was sugar. The wine was at first of very poor quality, and tasted of mousiness and bad acids. However, unlike No. 858 above, it gradually improved and lost nearly all of its unpleasant taste except the harsh acidity. At five years it was a fair wine.

These two experiments show that while high temperatures are injurious to both dry and sweet wines, they are absolutely fatal to the quality of the former, while the latter may recover to a certain extent, especially if they are fortified early. The fermentation of No. 1203 shows the inadequacy of full acidity to prevent the growth of bacteria in the must at high temperatures. Doubtless, however, if the acidity had been less, the injury would have been greater. It shows, also, how a wine may be completely invaded by bacteria when kept constantly warm, even though at no time during or after fermentation does the temperature go above 90° F. This is also an excellent illustration of a kind of fermentation which occurs frequently in cellars of the interior valleys. Musts with moderate and even low percentages of solid contents will stick with from 2% to 6% of unfermented sugar without ever attaining a dangerously high temperature. The cause is probably to be looked for in the kind of yeast which develops in the must, or in the deterrent effect on the yeast, of substances excreted by injurious ferments. The remedy in this case is the use of pure yeast or of yeast taken from a vat having a normal fermentation.

These experiments are supplemented by the large number of fermentations of Fresno and Tulare grapes made at this station. Though no special means were employed to keep down the temperature, the bulk of the fermentations may be considered cool, as compared with those taking place in the San Joaquin Valley. As little or no more bacterial troubles were experienced in the fermentation of Fresno and Tulare musts than with musts from cooler localities, the inference plainly is that the difference of must composition has less influence than the temperature conditions.

PLASTER AND AMMONIUM PHOSPHATE.

The difficulty of fermenting certain musts, especially those of the Zinfandel, from the interior valleys, suggested the series of experimental fermentations Nos. 1253, 1253*a*, and 1253*b*. The use of plaster, so general in Spain and the south of France, was compared with the use of ammonium phosphate, which has lately been recommended as a substitute, and with a normal fermentation. *Plaster* is supposed to act by increasing the acidity of the must and precipitating the albuminous matters, thereby favoring the growth of the vinous yeast, restricting the developing of secondary ferments, brightening the color, and causing a quicker clearing of the wine. *Ammonium phosphate* is supposed to act in a somewhat similar way and, besides, to increase the nitrogenous matters available for the nourishment of the yeast, thus causing quicker and more complete fermentation.

The grapes experimented with were Zinfandel from Fresno. They were received August 27, 1890, in good condition, and mature. The must showed 23.7% of solid contents by spindle and 0.54% of acid. The grapes were divided into three lots: No. 1253, No. 1253*a*, and No. 1253*b*. No. 1253 was fermented in the ordinary way; No. 1253*a* was fermented with the addition of 3 pro mille of calcium sulphate (plaster), and No. 1253*b* with 3 pro mille of ammonium phosphate. The temperature of the grapes at crushing was 72°. The maximum reached by No. 1253 was 77.5°, on the fourth day; the fermentation was slow, and on the seventh day the murk was drawn off while still sweet. The maximum reached by No. 1253*a* was 78°, on the fourth day; the fermentation was slow, but on the seventh day, when the murk was drawn off, it was less sweet than No. 1253. The maximum reached by No. 1253*b* was 86.5°, on the fourth day; the fermentation was quicker and more violent than either of the others, and on the fifth day, when the murk was drawn off, it was nearly dry.

No. 1253 (ordinary). One week after pressing the wine was quite dry, and in two weeks clear. In one month it was bright, and was racked. In two months it was bright, the lightest of the three in color, and rougher and less developed than No. 1253*a* and No. 1253*b*. The lees showed no bad germs except a few acetic; but two months later they showed some long filaments, and the wine was pasteurized. At eight months the wine was bright, of good flavor, with more bouquet than the others, and smoother than No. 1253*a*. At fifteen months it was in good order and preserved its superiority over No. 1253*a* and No. 1253*b*. It was quite mature, and two months later was bottled.

No. 1253*a* (plaster). One week after pressing the wine was quite dry, and in two weeks it was clear, and was racked. In two months it was bright, with more color than the control, but less than No. 1253*b*, without bouquet, and not equal to No. 1253*b* in flavor, but more developed than the control. The lees showed filaments at the same time as the control, and the wine was pasteurized at four months. It soon became bright, but at eight months it had less character than the control and had ceased to develop so quickly. At fifteen months it was bright and sound, with a little bouquet, good acid and astringency; a fair wine, but not equal in character to the control. It matured about the same time, and was bottled at seventeen months.

No. 1253*b* (ammonium phosphate). The wine was dry a few days after pressing, and in two weeks was clear, and was racked. In two months it was the best of the series; bright, of fair color, the only one with any bouquet, and of agreeable and vinous flavor. The lees were examined at the same time as the others, and some *S. pastorianus* found, but no unsound germs, except a few acetic. The wine was pasteurized at the same time as the others, in order that the conditions should be the same for all. After pasteurizing it did not improve as much as the others, but became a little flat. It was bottled at the same time.

ANALYSES OF THE WINES.

ZINFANDEL.	No. 1253. (Ordinary.)	No. 1253*a*. (Plaster.)	No. 1253*b*. (Am. Phos.)
Alcohol by volume	11.64%	11.45%	11.55%
Tannin	.199	.191	.199
Total acid as tartaric (at pressing)	.58	.59	.46
Total acid as tartaric (at six to eight months)	.45	.52	.48
Body	2.78	3.22	3.08
Ash	.31	.55	.48
Sugar	.22	.24	.22
Sulphuric acid	.032	.028	.213
Phosphoric acid	.060	.196	.966
Extract	2.52	2.61	2.74

The addition of both calcium sulphate (plaster or gypsum) and ammonium phosphate resulted in a quicker maturing of the wine. At two months there was a notable difference in maturity, cleanness of taste, and general quality in favor of the wine fermented with ammonium phosphate, and, in a less degree, of that fermented with plaster. Secondary ferments were found in the control and in the plastered wine, but not in the wine treated with ammonium phosphate. At fifteen months the position of the wines, with regard to quality, was exactly reversed—the control best and the plastered wine second—while the wine with ammonium phosphate, which when young was the best, had become flat, and was distinctly inferior to the others. With regard to color, the treated wines showed about twice as much as the untreated. All three were, however, of very poor color, both as regards intensity and tint; the difference was, on the whole, in favor of the plastered wine, which showed also somewhat higher acidity than the others.

With regard to the other constituents of the wine, the difference was inappreciable, except for an increase in the sulphuric acid, phosphoric acid, and consequently in the ash, of the treated wines. The amount of sulphuric acid in the plastered wine is double the maximum for natural wines, and corresponds to an amount of sulphate of potash sufficient to have a very appreciable effect on the human system, but is less than is found in some of the heavily plastered wines of Spain. It is probable that a smaller amount of plaster would have had an equal effect as far as improvement in the quality of the wine is concerned. The results obtained are in accordance with European experiences, and are not such as to encourage the use of either of the substances employed. Doubtless the same and better results can be obtained by the use of pure ferments, low temperature of fermentation, and, when necessary, the addition of tartaric acid.

The same conclusion is to be drawn from a series of experimental fermentations made with Carignane, from Mission San José. The following is a record of the experiment:

No. 1409, Carignane, from Mission San José. Received October 20, 1890, in fair condition, very soft and a few bunches moldy. The must showed 24.8% of solid contents by spindle and 0.95% of acid. The grapes were divided into five lots of 279 lbs. each, and treated as follows:

No. 1409 was fermented in the ordinary way, with foulage twice a day and floating top. The temperature at starting was 68°, and the maximum, reached the third day, was 100°.

No. 1409*a* was fermented in a closed vat with only three foulages during the time it remained in the vat. The initial temperature was 68°.

No. 1409*b* was fermented with the addition of 272 grams of calcium sulphate (plaster). The initial temperature was 68°, and the maximum, reached on the fourth day, was 98°.

No. 1409*c* was fermented with the addition of 272 grams of calcium phosphate. The initial temperature was 68°, and the maximum was 101.5°, reached on the fourth day.

No. 1409*d* was fermented with the addition of 272 grams of ammonium phosphate. The initial temperature was 68°, and the maximum reached was 101°, on the third day.

All were pressed on the sixth day, with the exception of No. 1409*a*, the closed fermentation. They were all a little sweet when drawn off; No. 1409*b* (plaster) was the sweetest and No. 1409*c* (phosphate) the driest, the others were about the same. No. 1409*a* (closed) was pressed on the thirteenth day. The upper part of the vat was full of gas, and the pomace smelled perfectly sound and good; when the murk was drawn off it was nearly dry.

No. 1409 (open vat). At one month the wine was clear, had an agreeable flavor and some aroma, clean taste, medium acid and astringency. It became bright, and was racked twice during the first two months, at the end of which time the lees showed lactic fermentation, and the wine was pasteurized. A month later it was bright, had good bouquet, no taste of lactic taint, and, next to No. 1409*b* (plaster), the best flavor of the series; it was, however, newer-tasting and less developed than No. 1409*b* (plaster). After this the wine deteriorated and did not keep well in glass.

No. 1409*a* (closed vat). One month after crushing the wine still contained a little sugar and was still cloudy. In three months it was bright, but still a little sweet. A month later the lees showed some lactic ferment, and the wine was pasteurized, though the taste was not affected. At five months the wine was bright, smooth, and clean-tasting; it had rather less flavor than No. 1409 (open vat), but the best bouquet of the series, and still had a trace of sweetness. At fifteen months it was in good condition, a little flat, but the best of the series. Some of the wine was bottled at seventeen months and some at twenty-five. At three years both wines were tasted, and the second bottling was found in good order, smooth, and of good flavor, but with little bouquet; it had improved in the bottle. The wine first bottled had not kept well.

No. 1409*b* (plaster). At one month the wine was clear, clean-tasting, with pleasant flavor, medium acid and astringency, and a little bouquet. At three months it was bright and still retained a little sweetness. The lees remained sound, and the wine was not pasteurized. At five months the wine had been racked three times, and was in good order; it had a slight bitter taste and the bouquet was not equal to that of the witness or the close-fermented wine (No. 1409 and No. 1409*a*), but the flavor was full and pleasing. After this the wine deteriorated, though the lees showed no bad ferments. It was bottled, part at seventeen and the rest at twenty-three months, but did not keep well in bottle.

No. 1409*c* (calcium phosphate). At one month the wine was clear, well flavored, and clean-tasting, but not quite equal to the open-vat sample. At three months it was bright, but not quite clean-tasting. A month later the lees showed lactic ferments, which had become perceptible to the taste, and the wine was pasteurized. At five months it was bright, but inferior to the first three of the series in flavor and bouquet, but superior to No. 1409*d* (ammonium phosphate). After this it deteriorated, but remained better than the latter.

No. 1409*d* (ammonium phosphate). The wine was bright one month after pressing, but was inferior to all the others of the series in flavor and aroma. At three months it had developed a little bouquet, but it was flat and its flavor was not very good. At four months the lees showed acetic and lactic ferments, and the wine was pasteurized. At five months it was clear, but not bright; no taste of lactic taint, but flat and the poorest in quality of the series. The wine did not improve and did not keep well in bottle.

ANALYSES OF THE WINES.

CARIGNANE.	No. 1409. (Open Vat.)	No. 1409*a*. (Closed Vat.)	No. 1409*b*. (Plaster.)	No. 1409*c*. (Calcium Phosphate.)	No. 1409*d*. (Ammonium Phosphate.)
Alcohol by volume	12.64%	13.09%	12.91%	12.18%	12.36%
Tannin	.213	.199	.213	.180	.217
Acid at pressing	.65	----------	----------	----------	----------
Acid at six months	.66	.54	.62	.56	.48
Body	3.08	2.82	3.94	3.22	3.82
Sugar	.32	.26	.28	.26	.22

It will be noted that the wine made in the closed vat had the largest amount of alcohol, there being no opportunity for loss by evaporation; in the plastered wine the slowing down of fermentation seems to have produced the same effect.

EXPERIMENTS WITH BARTH'S APPARATUS.

Two experimental fermentations were made with an apparatus invented and patented by Mr. Barth, of San Francisco. It consisted essentially of a frame to retain the pomace at the bottom of the fermenting-tank. It is so constructed that it can be used either in an open vat or in a large closed vat or cask entered by a manhole. Small experiments were tried at the Station, with entirely negative results. For details of the experiments, see Mataro, Nos. 1596, 1596*a*, 1611, and 1611*a*, page 114. The machine is intended for use in closed fermentations, the pomace being retained at the bottom to prevent the superheating of the cap. The experiments, therefore, were hardly a fair test of the machine, as, on account of the small quantity of grapes fermented, there was little opportunity for overheating. It is a very efficient and easily manipulated machine to accomplish the object in view, viz., to keep the pomace at the bottom of the vat.

EXPERIMENTS WITH COLOR GRAPES.*

Though California wines have, as a rule, an abundance of color, there are varieties which, in some localities, are lacking in this respect. In order to remedy this defect, varieties of grapes exceptionally rich in color are sometimes planted. As the bulk of the wine comes from the grapes of less color, it is important that the grapes of more color should be used economically; that is to say, in such a way as to obtain the maximum coloring effect from them. Several experiments have been made to discover the best way of doing this.

Three samples of wine were made from Cinsaut, and Petite Sirah, from Tulare—

No. 2138. Cinsaut alone.
No. 2139. Petite Sirah alone.
No. 2139*a*. Blend of Cinsaut 53% and Petite Sirah 47%.

The following table shows the color record:

Sample.	At Pressing.	At One Month.	At Two Months.	At Three Months.
No. 2138. Cinsaut	3R+Y 10.0	....	3R+Y 4.4	3R+Y 4.2
No. 2139. Petite Sirah	2VR 30.0	....	....	1R 7.1
No. 2139*a*. Blend	5VR 15.4	....	R 8.9	R 5.7

Thus, in three months the Cinsaut lost 59% of its color, the Petite Sirah 76.3%, and the blend 63%. It is to be noted that the tint of the blend was much better than that of the Cinsaut. The color is small in

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**Notation of Color Measurements.*—A detailed description of the method used at this laboratory to measure the color of red wine, and a full explanation of the scale, may be found on page 25 of the Viticultural Report, published in 1892. The letters used show the tint or shade of the wine, and run from violet-red to 3d red, according to the following scale:

Violet-Red.

1st violet-red.
2d violet-red.
3d violet-red.
4th violet-red.
5th violet-red.

Red.

1st red.
2d red.
3d red.

The brightest and most desirable tints are those near the top of the scale. They are the tints of the best color grapes and of new wines. As the wines become older the color changes under the influence of oxygen, and gradually drops down the scale, becoming finally yellowish or tawny. If the change continues after reaching the 3d red, the color is specified by adding letter Y to the other letters. This means that the color of the wine has become yellower than any of the tints of the scale, and that to obtain a perfect correspondence between the color of the wine and that of the scale it is necessary to look at the latter through a certain standard disk of yellow glass. Thus, when the color passes the 3d red it corresponds to the violet-red as seen through the yellow disk, and is indicated thus: VR+Y. This color then corresponds to what might have been called 4th red. The use of the yellow disk enables us to double the range of the scale, or to triple it by the use of two disks, though this is rarely necessary. Any wine whose color passes below the 3d red into the orange-reds may be considered defective, except in the case of sweet and fortified wines, which always show a yellowish tint.

The numbers after the letters indicate the intensity or amount of color possessed by a wine. No standard has been fixed as to the amount of color which a wine should possess. Any dry red wine, however, which drops below 10 may be considered deficient in amount of color, while any which retains over 25 at six months will bear dilution with lighter-colored wines.

amount, but the superiority of tint makes it a great improvement. There is an evident loss of color in fermenting the two grapes together, due to the taking up of color by the pomace of the Cinsaut. If the blend had been made directly after pressing, the color would have been 19.7 instead of 15.4. If, however, the wines had been kept for three months and then blended, the color would have been 5.5 instead of 5.7—a slightly greater loss than by fermenting the grapes together. These calculations are made on the supposition that there would be no actual loss of color in blending the two wines, which, judging from other experiments made, is not strictly true. To preserve the maximum amount of color, then, in this instance, it would have been best to have fermented each grape separately and blended the wines immediately after pressing.

An experiment made with Petit Bouschet and Clairette blanche gave results in some respects confirmatory of the above, in others apparently contradictory. The following were the samples made:

No. 2225. One third Petit Bouschet and two thirds Clairette blanche.

No. 2226. Petit Bouschet alone.

The blend was made before fermentation, and the color record is as follows:

Sample.	At Pressing.		At One Month.		At Two Months.		At Three Months.	
No. 2225. Blend	4VR	28.8	5VR	14.5	5VR	16.5	1R	7.3
No. 2226. Petit Bouschet	2VR	105.0	1VR	75.5	1VR	64.5	1VR	42.5

In this case the Petit Bouschet lost less (59.5%) of its color than did the blend (74.7%). This is doubtless due to the effect of the chemical composition of the Clairette blanche, rendering its wine less retentive of color than that of the Petit Bouschet. As in the former experiment, there is a loss of color in the blend, due probably to the taking up of color by the white pomace.

Apparently there should have been 35 of color in the blend; that is, one third of the amount in the Petit Bouschet alone, instead of 28.8. There is also a degradation of tint, slight at first, but very marked at three months.

There would doubtless have been some of this loss of intensity and degradation of tint even if the wines had been blended after pressing, for it seems to occur whenever wines of different intensities of color are blended, especially when one is a white wine. This is exemplified by the following series of experiments with wine made from Rupestris grapes.

No. 1907, Rupestris, from R. Hill, Glen Ellen, Sonoma County. The grapes were received in good condition on October 5, 1893. The bunches were cylindrical, well filled, and from two to three inches long; the berries spherical, from three to five lines (line=$\frac{1}{12}$ inch) in diameter, very ripe, and commencing to shrivel. The must showed 27.2% of solid contents by spindle and 0.64% of acid. Twenty-four pounds were crushed and fermented. The temperature of the must at starting was 67° F., and the maximum, reached on the third day, was 80° F. On the fourth day the wine was dry, and was drawn off. The color of the wine was extraordinary, far exceeding anything ever shown by European grapes. The color of the must before fermentation was 3R—83.3, which is higher than the average for red wines after fermentation. After fermentation the wine showed VR—444.4, a color so intense as to appear quite black before dilution. This amount of color is sufficient to allow of the addition of from 2,000% to 3,000% of white wine and still have a wine of good and sufficient color, providing there were no loss in blending. That there is a very considerable loss, however, is shown by the following experimental blends:

A. Rupestris undiluted.

B. Rupestris blended with Cinsaut of 1892 from Tulare. The color of the Cinsaut was so low as to be unreadable on the scale. It had 10.9% of alcohol by volume and 0.47% of acid.

C. Rupestris blended with Burger of 1892 from Tulare. The Burger had 9.73% of alcohol by volume and 0.51% of acid.

D. Rupestris blended with Carignane of 1893 from Tulare. The color of the Carignane was VR+1Y—4.2, its alcohol 9.9% by volume, and acid 0.53%.

E. Rupestris blended with Kleinberger of 1893 from Paso Robles. The Kleinberger had 9.0% of alcohol by volume and 0.6% of acid.

All these blends were made with 8% of Rupestris and 92% of the other variety.

TABLE OF COLOR READINGS.

Sample.	At Blending.	Loss.	At Two Weeks.	Loss.	At Two Months.	Loss.
A	VR 444.0	----------	VR 210	52.7%	4VR 143	67.8%
B	5VR 17.5	50.7%	3VR+1Y 13.8	21.2	----------	----------
C	2VR 22.9	35.5	4VR 14.3	37.5	1R 9.9	56.7
D	3VR 28.0	28.9	4VR 20.7	26.1	R 12.5	55.4
E	VR 30.3	14.7	4VR 18.7	38.3	3R 14.2	53.9

In the first column headed "loss" is given the proportion of color lost in blending: that is, how much color the blends lacked of 35.5 for B, C, and E, and of 39.4 for D, which they would have had if there had been no loss. The other two columns headed "loss" show the proportions lost after blending.

The loss after blending is fairly equal for all the blends, and is uniformly less than that of the unmixed Rupestris. The losses at blending, however, show great variation and indicate the great effect which the character of the white or light-colored wine used has on the color of the blend. The loss is greater when the blend is made with a one-year-old wine than when made with a new wine, as may be seen by comparing B and C with D and E. The last sample, E, shows a much smaller loss for the Paso Robles wine than for the three Tulare wines. There is the greatest loss with a one-year-old wine from Tulare, and the least with a new wine from Paso Robles. The effect of variety may be seen by comparing B with C. Here the Cinsaut, which is notoriously poor at keeping its color, has lost much more than the Burger of the same age and locality. It is to be noted, also, that the loss in blending is, roughly speaking, proportionate to the alcoholic strength and inversely proportionate to the acidity of the wine used.

We see, then, by these experiments, that the most effective way of utilizing the color of coloring grapes is to ferment them separately, and to make the blend immediately after pressing. If the grapes are fermented together, the pomace takes up too much of the color. If the blending is deferred any length of time after pressing there is a loss in another way, for, other things being equal, the deeper the color of a wine the more it loses in a given time. We also see that we cannot tell *a priori* how much of a certain wine must be added to another to produce a desired tint or depth of color. This can only be done experimentally, for the amount of color lost in blending varies according to the age and character of the wines blended.

ASAPROL.

Asaprol has been recommended as a means of preventing the attainment of too high temperatures during fermentation. It is a light, brown-pink powder, said to be innocuous, and, as its name indicates, tasteless. No data have been found as to its chemical composition, but probably, like many commercial products, it has no definite composition formula. All that seems to be known about it is that it is one of the coal-tar products, and is supposed to act in minute doses as a mild antiseptic, reducing the vigor of the yeast without permanently injuring it or preventing it from thoroughly eliminating the sugar. Thus, it is said, it causes the fermentation to be longer and less violent, but finally more complete. Its use is based on the same principle as that of sulphurous acid, and is intended to temporarily restrain the rapid multiplication of the yeast in the same way as do the sulphur fumes when sulphur is burned in a cask before putting in the must.

A series of experiments was undertaken with the object of ascertaining the truth of these claims. The first experiments were made with concentrated must containing the skins. As the must was four years old it probably contained little living yeast. It was diluted to 20.2% of solid contents, and strained from the skins. Three fermentations were made, as follows:

A. 1,500 c.c. Must with ½ gr. of asaprol.
B. 1,500 c.c. Must with ¼ gr. of asaprol.
C. 1,500 c.c. Must without addition.

The temperature of the must was 62° F., and there was no sign of fermentation in any of the vessels at the end of forty-eight hours. All were then warmed to 85° F. The next day the wine to which no addition had been made was giving off bubbles. The lees of all showed an abundance of micro-organisms, like yeast in appearance, but which were probably *Mycoderma vini*, for the next day they were all covered with a scum of wine-flowers, the treated wines thickly, the untreated less plentifully. The wine-flowers increased rapidly on the treated wines, and it was not until the sixth day that they gave off any gas. The scum soon disappeared from the wine without asaprol, and the fermentation became rapid, ceasing when the wine was dry, on the fourteenth day. The fermentation was very slow in the wines containing asaprol, and on the fourteenth day they were still sweet and covered with a remarkably thick scum of wine-flowers. These experiments showed that a dose of 0.017% of asaprol had a marked deterrent effect on alcoholic fermentation, but was apparently favorable to the development of wine-flowers. A parallel set of experiments was made, differing from the above only in having the must with 25.5% of solid contents. There was an abundant development of wine-flowers in all, but no fermentation, showing that there was no yeast present, or that the yeast was too much debilitated to ferment in so strong a must.

For another experiment the must was diluted to 24.0% of solid contents and 0.60% of acid. To 1,500 c.c. of must 1 gram of asaprol was added. This, together with a control fermentation of the same size without addition, was kept in a warm chamber, at 80° to 82° F. Both fermented and showed an abundance of wine-flowers, but neither went through. At this temperature the asaprol had apparently no effect. The same must, with 1% of asaprol, did not ferment at all.

In order to obtain results under more nearly normal conditions, another series of experiments was made later with fresh grape-juice. The must had 23.0% of solid contents by spindle, and was divided into the following lots: A, to which was added 0.5% of asaprol; B, 0.1%; C, 0.05%; D, 0.01%, and E, to which no addition was made.

The fermentations were carried on in bottles containing each 100 gr. of must, kept in a room at 66° to 68° F. The bottles of must were sterilized, and when cool 3 c.c. of fermenting must and the indicated amount of asaprol were added to each. The must containing 0.5% of asaprol fermented very slowly, and at fifteen days contained 2.8% of alcohol and 15.6% of solid contents by spindle. It tasted perfectly dry, showing that, though there had been little fermentation, the sugar had undergone some chemical change.

At fifteen days the three wines containing the smallest amounts of asaprol were cloudy, while that containing the largest amount and the witness containing none were nearly clear. The musts containing 0.1% and 0.05% fermented more slowly and regularly than the witness. The witness and the must containing 0.01% fermented more violently during the first few days, but at fifteen days had not eliminated any more sugar than the others, with the exception of the one containing 0.5% of asaprol. When all visible signs of fermentation were over, the wine containing the heaviest dose of asaprol tasted quite dry, and all the others slightly and about equally sweet. The following table of analyses, made by Mr. G. E. Colby, shows the alcoholic and solid contents of each sample at fifteen days and at the end of all sensible fermentation:

Description of Experiments.	Alcohol at Fifteen Days.	Solid Contents by Spindle at Fifteen Days.	Solid Contents by Spindle at End of Fermentation.
A, containing 0.50% of asaprol	2.8%	15.6%	11.4%
B, containing 0.10% of asaprol	9.4	7.3	4.3
C, containing 0.05% of asaprol	9.9	7.1	3.7
D, containing 0.01% of asaprol	9.9	6.8	4.4
E, containing no addition	9.1	7.3	4.0

These experiments show that asaprol used in the ratio of about 5 to 10,000 of must has a slackening and regulating effect on the fermentation without preventing the final and complete conversion of the sugar into alcohol. The latter is a fair conclusion, for, though none of the wines became perfectly dry, the amount of sugar in the witness was equal to that in the wine containing the above quantity of asaprol. In the ratio of 1 to 10,000 it has little or no effect, unless the yeast is in an inactive condition. In doses of 5 to 1,000 it seriously impedes alcoholic fermentation, and spoils the wine by destroying or changing the sugar without the production of alcohol.

If used in the ordinary fermenting-vats, therefore, asaprol would doubtless have the effect claimed for it, viz., by weakening and retarding the fermentation to prevent the undue heating of the wine. It has the advantage over sulphurous fumes of giving no taste to the wine. It is, however, subject to the same objections as other antiseptics. It is probably, like them, injurious to the stomach, even in small doses, and should certainly not be used until more is known of its nature in this regard.

Our experiments tend to show, also, that its action is greater upon alcoholic yeasts than upon other organisms and ferments in the must. Thus, while preventing undue heating, by hampering the development of the yeast, it allows other organisms to take possession of the wine, causing, in another way, the very trouble it is intended to prevent. It is very doubtful, then, if asaprol can be used with any more advantage than sulphur, and as the ends intended to be attained by the use of these antiseptics can be easily compassed by purely mechanical means, there remains no excuse or need for their use.

ON THE QUANTITIES OF NITROGENOUS MATTERS CONTAINED IN CALIFORNIA MUSTS AND WINES.

By George E. Colby.

Introductory Note, by E. W. Hilgard.—The nitrogenous substances contained in grapes and wine have heretofore formed the subject of a number of investigations, but the conclusions reached as to the nature of these substances, and of the part they play in respect to the various qualities and diseases of wine, have not been as definite as could be desired, largely because of the failure to continue them systematically through a number of years with wines derived from different localities. The importance of the problems involved, specially as regards the connection with the fermenting and keeping qualities, and the variety of climates and soils existing in California, seemed to render this State particularly adapted to experimental investigation of this subject; which has now continued for a sufficient length of time, and has accumulated enough data, to determine definitely some points at least in the complex question. A preliminary account of the first part of this work was prepared by Mr. L. Paparelli, formerly assistant in charge of viticulture at the University, and Mr. George E. Colby, the chemical assistant in charge of viticultural work; it was read at the Indianapolis meeting of the Society for the Promotion of Agricultural Science, in August, 1890. The conclusions then reached were largely tentative, because of the relatively small number of determinations then available; they have since been greatly extended by Mr. Colby's work, and, on the whole, the conclusions first reached have been closely verified.

Broadly stated, these may be said to be that the *absolute amounts* of nitrogen in wines stand in no direct relation either to intrinsic excellence (as has been repeatedly affirmed) or to the keeping qualities of wines; and that the significance of the nitrogenous ingredients of wines must be sought in their *kind* and not in their total amounts. It is intended to prosecute this part of the research as time and means will permit, in connection with the data already obtained.

While there can be no question of the propriety of removing as far as possible a certain portion of the nitrogenous matters prior to fermentation (usually by aëration of the must), and while there can be little question that the portion thus precipitated contains true albuminoids, it is extremely probable that a large but variable part of the remaining nitrogen is contained in the form of compounds of the "amido" class, which are not affected by the reagents used to precipitate albuminoids, but are well known to serve in building up the latter for use in plant tissues, while also forming an intermediate stage in their final breaking-down, of which urea is the last link. It will be of no little interest, theoretical as well as (probably) practical, to determine the nature of these intermediate substances and their relation to the nutrition of yeast and the various qualities of wines. But such investigations are extremely difficult and complex, requiring both ample time and copious resources to be carried to a successful issue. (E. W. H.)

The nitrogenous substances in wine, and the part they play in fermentation and diseases of wine, have heretofore been studied by many chemists. In a country like California, where viticulture takes so important a place, the study of the qualities of albuminoid matters in the musts and wines of the State becomes necessary with a view to the possible explanation of their influence on quality and of the causes of their numerous diseases; above all, of lactic fermentation, which is the most common trouble of California wines. This is the more important as most of the wines attacked by lactic fermentation are rebellious to all treatments for conservation; pasteurizing having but little beneficial effect, save as a preventive measure.

We have, therefore, begun and carried on the study of the question and its relation to the condition of the soil, season, growth of vines, temperature of fermentation, etc.—data which influence materially the chemical composition of musts and wines.

Selection has been made of the characteristic members of each type of grape grown at the various culture sub-stations of the department, and an effort has been made to represent for the red-wine varieties all the grape-growing regions of California. Doubtless, had the work been advanced further for the white-wine varieties of grapes the results would have been very similar to those here given for the red-wine varieties.

The musts examined were filtered and analyzed by the Kjeldahl method for the determination of nitrogen; the nitrogen contained in the musts and wine may be calculated as "albuminoids" by use of the usual coefficient of 6.25. Many of the musts examined had no corresponding wine, because of lack of enough grapes for the fermentation experiment.

All but about one dozen of the wines reported in the tables below were made here at the station; a description of the methods of fermentation, age, etc., will be found in the part of this report relating to wines.

Four points of view presented themselves primarily, viz.:

1. The difference in nitrogen between types and varieties;

2. The influence of different climatic and soil conditions upon the nitrogen of the musts;

3. The changes brought about by the vinification of the musts by one and the same method of treatment;

4. The differences that may result from the different methods of vinification in one and the same as well as in different musts.

It need hardly be said that to carry out such investigations for a large number of these variable and inter-connected data with all their various combinations, would form the work of several lifetimes; but it is to be hoped that in the course of research some guiding principles will be evolved that will materially abridge the labors of the analysts and convey important practical information to the wine-maker.

Table A illustrates the first three points of view. Tables B and C aid, each in its particular place, to emphasize and clearly separate the facts compiled in Table A. Table D shows the fourth point.

TABLE A.

DETERMINATION OF NITROGEN (*Resp.* "ALBUMINOIDS") IN SAMPLES OF FILTERED MUSTS (VINTAGES OF 1889, 1890, 1891, 1892, AND 1893), AND IN SAMPLES OF WINE MADE FROM THE SAME MUSTS.

(NOTE.—R placed after the number indicates wines sent for examination.)

Number	Variety and Place of Production.	Vintage	MUST.		WINE.					
			Nitrogen Per Cent.	Albuminoids Per Cent.	Nitrogen Per Cent.	Albuminoids Per Cent.	Differences, Albuminoids in Must and Wine.		Body	Per Cent of Nitrogen in 100 Body
							Absolute	Per Cent.		
	BORDEAUX TYPE.									
	Cabernet Sauvignon.									
1820	Amador station	1893	.025	.156	------	------	------	------	------	------
1347	Cupertino	1890	.082	.513	------	------	------	------	------	------
1632R	Gubserville	1885	------	------	.041	.256	------	------	3.10	1.32
1633R	Gubserville	1887	------	------	.057	.356	------	------	2.55	2.24
1640R	Gubserville	1889	------	------	.057	.356	------	------	2.60	2.19
1634R	Gubserville	1890	------	------	.037	.243	------	------	2.05	1.84
1635R	Gubserville	1890	------	------	.035	.219	------	------	3.23	1.08
1636R	Gubserville	1891	------	------	.049	.306	------	------	2.80	1.75
1113	Mission San José	1889	.097	.606	.089	.556	.046	8.2	2.78	3.20
1342	Mission San José	1890	.060	.375	.042	.262	.113	30.1	2.78	1.54
1765	Mission San José	1892	.075	.468	.038	.237	.191	49.3	2.85	1.34
1248	Fresno	1890	.036	.225	------	------	------	------	------	------
2207	Tulare	1894	.071	.444	------	------	------	------	------	------
1554	Paso Robles	1891	.076	.475	------	------	------	------	------	------
1914	Paso Robles	1893	.062	.387	.055	.343	.040	11.3	3.10	1.80
	Cabernet Franc.									
1336	Cupertino	1890	.042	.263	------	------	------	------	------	------
1522	Mission San José	1891	.088	.550	------	------	------	------	------	------
1559	Paso Robles	1891	.080	.500	------	------	------	------	------	------
	Gros Verdot.									
1331	Cupertino	1890	.041	.256	------	------	------	------	------	------
1631R	Gubserville	1891	------	------	.042	.263	------	------	3.02	1.06
1382	Mission San José	1890	.098	.613	.052	.325	.288	46.9	3.32	1.53
1250	Fresno	1890	.059	.368	------	------	------	------	------	------
1681	Tulare	1892	.138	.862	------	------	------	------	------	------
1551	Paso Robles	1891	.091	.569	------	------	------	------	------	------
	Malbeck.									
2195	Amador station	1893	.037	.231	------	------	------	------	------	------
1321	Cupertino	1890	.053	.330	------	------	------	------	------	------
1303	Mission San José	1890	.092	.577	------	------	------	------	------	------
1475	Fresno	1891	.063	.393	------	------	------	------	------	------
1797	Tulare	1893	.070	.437	.053	.331	.106	24.0	3.80	1.39
1489	Paso Robles	1891	.081	.506	------	------	------	------	------	------
1917	Paso Robles	1893	.077	.481	.047	.294	.187	38.9	3.30	1.42
	Tannat.									
1835	Amador station	1893	.014	.087	------	------	------	------	------	------
1389	Cupertino	1890	.037	.231	------	------	------	------	------	------
1302	Mission San José	1890	.125	.782	.068	.425	.357	45.7	3.50	1.94
2322	Tulare	1894	.041	.256	------	------	------	------	------	------
1560	Paso Robles	1891	.079	.493	------	------	------	------	------	------
1911	Paso Robles	1893	.060	.375	.026	.162	.213	56.7	3.30	.78
	Teinturier mâle.									
2196	Amador station	1894	.064	.400	------	------	------	------	------	------
1283	Cupertino	1890	.066	.413	.035	.219	.194	47.0	3.28	1.06
1292	Mission San José	1890	.102	.638	.058	.362	.276	43.2	2.78	2.08
1205	Fresno	1890	.063	.394	.029	.181	.213	54.1	3.20	.90
1943	Tulare	1893	.141	.881	------	------	------	------	------	------
1497	Paso Robles	1891	.092	.575	.074	.463	.112	19.5	3.05	2.42

TABLE A—Continued.

Number	Variety and Place of Production.	Vintage	MUST.		WINE.					
			Nitrogen Per Cent.	Albuminoids Per Cent	Nitrogen Per Cent.	Albuminoids Per Cent	Differences, Albuminoids in Must and Wine.		Body	Per Cent of Nitrogen in 100 Body.
							Absolute	Per Cent		
	Gamai Teinturier.									
1823	Amador station	1893	.016	.100	------	------	------	------	------	------
1073	Cupertino	1889	------	------	.019	.121	------	------	3.07	.62
1276	Cupertino	1890	.047	.294	.023	.142	.152	51.9	2.58	.85
1058	Mission San José	1889	------	------	.049	.307	------	------	2.65	1.85
1294	Mission San José	1890	.080	.500	.044	.273	.227	45.4	3.08	1.10
1228	Fresno	1890	.039	.244	------	------	------	------	------	------
2209	Tulare	1894	.089	.556	------	------	------	------	------	------
1866	Paso Robles	1893	.082	.513	.043	.268	.245	47.7	2.95	1.45
	St. Macaire.									
2197	Amador station	1894	.041	.256	------	------	------	------	------	------
1281	Cupertino	1890	.056	.350	.024	.150	.200	57.1	3.08	.79
1637R	Gubserville	1890	------	------	.034	.212	------	------	2.85	1.19
1638R	Gubserville	1891	------	------	.046	.287	------	------	3.00	1.53
1295	Mission San José	1890	.070	.438	.023	.142	.296	67.1	2.82	.82
1706	Mission San José	1892	.055	.344	.026	.163	.181	52.6	3.20	.80
1443	Tulare	1891	.079	.493	------	------	------	------	------	------
1846	Tulare	1893	.076	.477	.041	.256	.221	46.3	3.30	1.24
	BURGUNDY TYPE.									
	Pinot de Pernand.									
1367	Cupertino	1890	.067	.419	------	------	------	------	------	------
1504	Mission San José	1891	.097	.606	------	------	------	------	------	------
1258	Mission San José	1890	.100	.625	.050	.313	.312	50.0	3.10	1.61
1799	Tulare	1893	.094	.577	------	------	------	------	------	------
1226	Fresno	1890	.101	.631	------	------	------	------	------	------
1480	Paso Robles	1891	.074	.472	------	------	------	------	------	------
	Pinot St. George.									
1819	Amador station	1893	.040	.250	.019	.119	.132	52.8	3.30	.59
1332	Cupertino	1890	.110	.688	------	------	------	------	------	------
1508	Mission San José	1891	.083	.519	------	------	------	------	------	------
1910	Mission San José	1893	.070	.437	.033	.207	.230	52.6	2.40	1.37
1224	Fresno	1890	.083	.519	------	------	------	------	------	------
2005	Tulare	1893	.057	.356	------	------	------	------	------	------
1480	Paso Robles	1891	.067	.419	------	------	------	------	------	------
	Meunier.									
1808	Amador station	1893	.042	.262	------	------	------	------	------	------
1280	Cupertino	1890	.043	.269	------	------	------	------	------	------
1259	Mission San José	1890	.087	.544	------	------	------	------	------	------
1212	Fresno	1890	.060	.375	------	------	------	------	------	----
2309	Tulare	1894	.063	.394	------	------	------	------	------	------
1558	Paso Robles	1891	.047	.295	------	------	------	------	------	------
	**Chauché noir.*									
1832	Amador station	1893	.030	.187	------	------	------	------	------	------
1290	Cupertino	1890	.065	.406	------	------	------	------	------	------
1298	Mission San José	1890	.117	.731	.056	.345	.381	52.0	2.45	2.22
1446	Tulare	1891	.165	1.031	------	------	------	------	------	------
1620	Tulare	1892	.188	1.175	.105	.656	.519	44.1	3.00	3.50
1557	Paso Robles	1891	.070	.437	------	------	------	------	------	------
1868	Paso Robles	1893	.079	.494	.038	.237	.257	52.0	3.10	1.22

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*The Chauché noir is classed with the Burgundies because it is used largely in the make-up of wines sent out under that name.

TABLE A—Continued.

Number.	Variety and Place of Production.	Vintage	MUST. Nitrogen Per Cent	MUST. Albuminoids Per Cent	WINE. Nitrogen Per Cent.	WINE. Albuminoids Per Cent	WINE. Differences, Albuminoids in Must and Wine. Absolute	WINE. Differences, Albuminoids in Must and Wine. Per Cent.	WINE. Body	WINE. Per Cent of Nitrogen in 100 Body.
	Robin noir.									
2199	Amador station	1894	.033	.206	-----	-----	-----	-----	-----	-----
1284	Cupertino	1890	.025	.156	-----	-----	-----	-----	-----	-----
1428	Mission San José	1890	.056	.350	-----	-----	-----	-----	-----	-----
1953	Mission San José	1893	.062	.385	.049	.306	.078	20.3	2.60	1.88
1230	Fresno	1890	.026	.162	-----	-----	-----	-----	-----	-----
2336	Tulare	1894	.045	.281	-----	-----	-----	-----	-----	-----
1552	Paso Robles	1891	.104	.650	-----	-----	-----	-----	-----	-----
	SOUTHERN FRENCH TYPE.									
	Petite Sirah.									
1278	Cupertino	1890	.065	.406	-----	-----	-----	-----	-----	-----
1296	Mission San José	1890	-----	-----	.052	.325	-----	-----	3.45	1.50
1492	Paso Robles	1891	.085	.531	-----	-----	-----	-----	-----	-----
	Serine.									
2086	Amador station	1894	.051	.319	-----	-----	-----	-----	-----	-----
1147	Cupertino	1889	-----	-----	.035	.229	-----	-----	3.50	1.00
1370	Cupertino	1890	.061	.381	-----	-----	-----	-----	-----	-----
1341	Mission San José	1890	.088	.551	.047	.294	.257	46.9	3.32	1.40
1042	Fresno	1889	-----	-----	.044	.275	-----	-----	3.80	1.15
1242	Fresno	1890	.055	.344	.027	.168	.176	51.1	2.70	1.00
1438	Tulare	1891	.103	.643	-----	-----	-----	-----	-----	-----
1814	Tulare	1893	.109	.681	.067	.419	.262	38.4	3.20	2.10
1488	Paso Robles	1891	.072	.450	-----	-----	-----	-----	-----	-----
1895	Paso Robles	1893	.089	.546	.054	.337	.209	39.3	3.30	1.66
	Mondeuse.									
2174	Amador station	1894	.022	.137	-----	-----	-----	-----	-----	-----
1595	Los Guilicos	1891	.041	.256	.027	.168	.088	34.1	3.35	.81
1812	Cupertino	1890	.052	.325	.016	.100	.225	69.1	2.70	.59
1151	Cupertino	1889	.080	.500	.056	.351	.149	30.0	3.05	1.85
1142	Mission San José	1889	.088	.550	.073	.456	.094	17.0	2.87	2.50
1334	Mission San José	1890	.071	.444	.028	.175	.269	60.5	2.58	1.08
1639R	Gubserville	1891	-----	-----	.032	.200	-----	-----	2.55	1.25
1888	Tulare	1893	.056	.350	.024	.150	.200	57.1	2.30	1.04
1922	Paso Robles	1893	.068	.425	.036	.225	.200	47.1	3.30	1.09
	Cinsaut.									
1825	Amador station	1893	.044	.275	-----	-----	-----	-----	-----	-----
2050	Cupertino	1893	.056	.350	-----	-----	-----	-----	-----	-----
1408	Mission San José	1890	.095	.596	.053	.331	.265	44.4	2.58	2.05
1477	Paso Robles	1891	.077	.481	-----	-----	-----	-----	-----	-----
1434	Tulare	1891	.171	1.069	.124	.775	.284	27.4	3.80	3.26
1614	Tulare	1892	.140	.870	.093	.581	.289	33.2	2.95	3.10
	Mataro.									
1069	Amador station	1889	.045	.281	.021	.131	.151	53.3	2.70	.80
1255	Amador station	1890	.036	.225	.015	.094	.131	58.1	2.58	.58
1596	Asti, Sonoma County	1891	.037	.231	.022	.137	.094	40.8	3.35	.66
1609	Mountain View	1891	.049	.306	.019	.119	.187	61.1	2.55	.74
1610	San José	1891	.029	.179	.010	.063	.116	65.3	2.45	.41
1252	Fresno	1890	.035	.218	.011	.069	.149	69.8	2.32	.47
1921	Paso Robles	1893	.076	.475	.023	.144	.331	69.6	2.30	1.00
2313	Tulare	1894	.042	.262	-----	-----	-----	-----	-----	-----

TABLE A—Continued.

Number	Variety and Place of Production.	Vintage	MUST.		WINE.					
			Nitrogen Per Cent	Albuminoids Per Cent	Nitrogen Per Cent	Albuminoids Per Cent	Differences, Albuminoids in Must and Wine. Absolute	Differences, Albuminoids in Must and Wine. Per Cent	Body	Per Cent of Nitrogen in 100 Body
	Carignane.									
1070	Amador station	1889	.032	.200	.011	.069	.131	65.6	3.07	.36
1525	Asti, Sonoma County	1891	.026	.162	.010	.063	.099	61.9	2.78	.39
1335	Cupertino	1890	.050	.313	-----	-----	-----	-----	-----	-----
1409	Mission San José	1890	.100	.625	.048	.300	.325	52.0	3.08	1.55
1251	Fresno	1890	.026	.163	.007	.044	.119	72.4	2.36	.28
1447	Tulare	1891	.058	.362	-----	-----	-----	-----	-----	-----
1628	Tulare	1892	.065	.406	.031	.194	.212	52.2	3.30	.94
1887	Tulare	1893	.075	.469	.035	.219	.260	53.4	2.60	1.34
1576	Paso Robles	1891	.049	.306	.033	.206	.100	32.6	2.60	1.27
	Grenache.									
1822	Amador station	1893	.034	.212	-----	-----	-----	-----	-----	-----
1333	Cupertino	1890	.053	.331	-----	-----	-----	-----	-----	-----
1249	Fresno	1890	.020	.125	.015	.094	.031	24.8	3.02	.50
1444	Tulare	1891	.068	.425	-----	-----	-----	-----	-----	-----
1626	Tulare	1892	.060	.375	.041	.256	.119	31.7	2.90	1.40
1527	Paso Robles	1891	.070	.440	-----	-----	-----	-----	-----	-----
1721	Paso Robles	1892	.050	.313	.028	.175	.138	44.0	2.85	.99
	César.									
1594	Los Guilicos	1891	.072	.045	.045	.281	.169	37.5	3.35	1.34
	Petit Bouschet.									
1394	Cupertino	1890	.094	.588	-----	-----	-----	-----	-----	-----
1378	Mission San José	1890	.100	.625	.052	.325	.300	48.0	3.32	1.56
1245	Fresno	1890	.097	.606	-----	-----	-----	-----	-----	-----
1435	Tulare	1891	.060	.375	.045	.281	.094	25.1	3.12	1.40
1529	Paso Robles	1891	.091	.568	-----	-----	-----	-----	-----	-----
2009	Paso Robles	1893	.079	.493	.051	.319	.174	35.3	3.10	1.64
	Aramon.									
2316	Amador station	1894	.040	.250	-----	-----	-----	-----	-----	-----
1189	Cupertino	1889	-----	-----	.015	.095	-----	-----	3.50	.43
1414	Cupertino	1890	.060	.375	.033	.206	.169	45.1	2.82	1.18
1175	Mission San José	1889	-----	-----	.042	.273	-----	-----	2.67	1.60
1377	Mission San José	1890	.081	.506	.046	.287	.219	43.3	2.58	1.70
1246	Fresno	1890	.035	.219	.011	.069	.150	68.3	2.82	.38
1436	Tulare	1891	.055	.344	-----	-----	-----	-----	-----	-----
1639	Tulare	1892	.061	.381	.032	.200	.181	47.3	2.65	1.20
1755	Paso Robles	1892	.055	.344	-----	-----	-----	-----	-----	-----
	AUSTRIAN AND HUNGARIAN TYPE.									
	Zinfandel.									
1071	Amador station	1889	.043	.269	.028	.175	.094	34.9	3.07	.90
1257	Amador station	1890	.021	.131	.013	.081	.050	38.1	2.82	.45
1098	Fresno	1889	.061	.381	.047	.294	.087	22.9	3.50	1.34
1253	Fresno	1890	.030	.187	.015	.094	.093	49.9	2.78	.54
	Blue Portuguese.									
1365	Cupertino	1890	.061	.381	-----	-----	-----	-----	-----	-----
1262	Mission San José	1890	.087	.544	.042	.262	.282	51.7	2.58	1.60
1206	Fresno	1890	.057	.356	.025	.156	.200	56.1	3.08	.80
1440	Tulare	1891	.104	.650	-----	-----	-----	-----	-----	-----
1618	Tulare	1892	.090	.560	.067	.419	.141	25.4	3.08	2.20
1481	Paso Robles	1891	.077	.481	-----	-----	-----	-----	-----	-----
	Rothgipfler (White).									
1800	Amador station	1893	.065	.406	-----	-----	-----	-----	-----	-----
1359	Mission San José	1890	.063	.396	-----	-----	-----	-----	-----	-----
1530	Paso Robles	1891	.077	.481	-----	-----	-----	-----	-----	-----

TABLE A—Continued.

Number.	Variety and Place of Production.	Vintage.	MUST.		WINE.					
			Nitrogen Per Cent.	Albuminoids Per Cent.	Nitrogen Per Cent.	Albuminoids Per Cent.	Differences, Albuminoids in Musts and Wine.		Body.	Per Cent of Nitrogen in 100 Body.
							Absolute.	Per Cent.		
	Marzemino.									
1293	Cupertino	1890	.065	.406	------	------	------	------	------	------
1358	Mission San José	1890	.042	.252	------	------	------	------	------	------
1231	Fresno	1890	.014	.087	------	------	------	------	------	------
	Grüner Velteliner (White).									
1306	Cupertino	1890	.047	.293	------	------	------	------	------	------
1346	Mission San José	1890	.075	.468	.025	.156	.312	66.6	2.58	.94
1208	Fresno	1890	.041	.256	.017	.106	.150	58.6	1.80	.94
	Kadarkas.									
1307	Cupertino	1890	.071	.443	.032	.200	.243	54.8	2.58	1.24
1418	Mission San José	1890	.107	.668	.076	.475	.188	28.9	3.58	2.13
1461	Fresno	1891	.064	.400	------	------	------	------	------	------
	White Vernaccia.									
1400	Cupertino	1890	.045	.281	------	------	------	------	------	------
1422	Mission San José	1890	.072	.450	------	------	------	------	------	------
1236	Fresno	1890	.043	.268	------	------	------	------	------	------
1549	Paso Robles	1891	.079	.493	------	------	------	------	------	------
	NORTH ITALIAN TYPE.									
	Fresa.									
2175	Amador station	1894	.034	.212	------	------	------	------	------	------
1327	Cupertino	1890	.065	.406	------	------	------	------	------	------
1469	Fresno	1891	.059	.369	------	------	------	------	------	------
2318	Tulare	1894	.049	.306	------	------	------	------	------	------
1553	Paso Robles	1891	.086	.537	------	------	------	------	------	------
	Barbera.									
2276	Asti, Sonoma County	1894	.057	.356	------	------	------	------	------	------
1324	Cupertino	1890	.085	.531	------	------	------	------	------	------
1573	Mission San José	1891	.065	.406	.034	.213	.193	47.7	3.25	1.04
1445	Tulare	1891	.094	.587	------	------	------	------	------	------
1675	Tulare	1892	.075	.468	.032	.200	.268	57.3	3.20	1.00
	Nebbiolo, or Spanna.									
1857	Amador station	1893	.034	.212	------	------	------	------	------	------
2277	Asti, Sonoma County	1894	.037	.231	------	------	------	------	------	------
1401	Cupertino	1890	.056	.350	----	------	------	------	------	------
1285	Cupertino	1890	.028	.175	------	------	------	------	-----	------
1554	Paso Robles	1891	.067	.419	------	------	------	------	------	------
1954	Paso Robles	1893	.085	.531	.052	.325	.206	38.8	2.85	1.83
1958	Paso Robles	1893	.074	.462	------	------	------	------	------	------
	Refosco.									
1416	Cupertino	1890	.084	.525	------	------	------	------	------	------
1584	Mission San José	1891	.112	.700	.056	.350	.350	50.0	3.45	1.62
	Crabb's Black Burgundy.									
1526	Asti, Sonoma County	1891	.042	.262	.028	.175	.087	33.3	2.95	.94
1318	Cupertino	1890	.057	.356	.030	.187	.169	47.4	2.78	1.06
1343	Mission San José	1890	.091	.569	.041	.256	.313	55.0	3.32	1.20
1219	Fresno	1890	.081	.506	------	------	------	------	------	------
1437	Tulare	1891	.081	.506	------	------	------	------	------	------
1615	Tulare	1892	.088	.550	.040	.250	.300	54.5	3.05	1.38
1496	Paso Robles	1891	.068	.425	.047	.293	.132	30.8	2.80	1.60

TABLE A—Continued.

Number	Variety and Place of Production.	Vintage	MUST.		WINE.					
			Nitrogen Per Cent.	Albuminoids Per Cent.	Nitrogen Per Cent.	Albuminoids Per Cent.	Differences, Albuminoids in Must and Wine.		Body	Per Cent of Nitrogen in 100 Body.
							Absolute	Per Cent.		
	Dolcetto.									
1572	Asti, Sonoma County	1891	.049	.308	.027	.168	.140	45.4	2.60	1.30
	Barolo.									
1575	Asti, Sonoma County	1891	.064	.400	.033	.206	.194	48.5	3.20	1.03
	Bonarda.									
1384	Cupertino	1890	.055	.344	.023	.144	.200	58.1	2.58	.85
1362	Cupertino	1890	.055	.344	.035	.219	.125	36.3	2.70	1.29
1385	Cupertino	1890	.067	.418	------	------	------	------	------	------
2310	Tulare	1894	.071	.444	------	------	------	------	------	------
1869	Paso Robles	1893	.079	.493	.045	.281	.212	43.0	2.80	1.60
	Gros Mansenc.									
2198	Amador station	1893	.034	.212	------	------	------	------	------	------
1277	Cupertino	1890	.056	.350	.028	.175	.175	50.0	2.82	.98
1339	Mission San José	1890	.087	.544	.038	.237	.307	56.4	2.82	1.36
1243	Fresno	1890	.050	.313	.016	.100	.213	68.0	2.95	.54
1899	Tulare	1893	.088	.548	.049	.306	.242	44.3	3.80	1.29
1547	Paso Robles	1891	.066	.412	------	------	------	------	------	------
2063	Paso Robles	1893	.093	.582	.049	.306	.276	47.3	2.85	1.72

EXAMINATION OF THE MUSTS.

Differences between the Different Types.—In estimating the averages for each type, no regard has been paid to season or locality of growth, nor to the climatic or soil conditions of individual samples, as these may be considered as common to each type. In this table the arrangement of types is from highest to lowest in average content of nitrogen.

Burgundy, 33 samples	.072
Bordeaux, 55 samples	.070
North Italian, 34 samples	.066
Southern French, 61 samples	.064
Hungarian, 22 samples	.060

It is thus seen at a glance that the Burgundy and Bordeaux types are nearly equal in their content of nitrogen, and that while the variation in average amount of nitrogen in the musts for the several types is quite small, the Burgundy and Bordeaux types stand highest, while the Hungarian is lowest in the group.

Differences between Different Varieties.—In the five types chosen for these examinations there are embraced thirty-nine varieties of grapes, each variety being represented by samples grown under varying conditions; the averages may, therefore, be regarded as fairly comparable. They are arranged in the following table in order of highest to lowest:

AVERAGE AMOUNT OF NITROGEN IN GRAPE-VARIETIES.

Chauché noir, 7 samples	.107	Bonarda, 5 samples	.065
Refosco, 2 samples	.098	St. Macaire, 6 samples	.063
Cinsaut, 6 samples	.095	Barolo, 1 sample	.061
Pinot de Pernand, 6 samples	.088	Tannat, 6 samples	.060
Teinturier mâle, 6 samples	.088	Gamai Teinturier, 6 samples	.060
Petit Bouschet, 6 samples	.086	White Vernaccia, 4 samples	.060
Gros Verdot, 5 samples	.085	Mondeuse, 8 samples	.059
Kadarkas, 3 samples	.080	Fresa, 5 samples	.058
Blue Portuguese, 6 samples	.079	Meunier, 6 samples	.057
Petite Sirah, 2 samples	.075	Aramon, 7 samples	.055
Pinot St. George, 7 samples	.075	Spanna, 7 samples	.054
Barbera, 5 samples	.075	Grüner Velteliner, 3 samples	.054
Serine, 8 samples	.074	Carignane, 9 samples	.053
Crabb's Black Burgundy, 7 samples	.072	Robin noir, 7 samples	.051
César, 1 sample	.072	Grenache, 7 samples	.050
Cabernet Franc, 3 samples	.070	Dolcetto, 1 sample	.049
Malbeck, 7 samples	.069	Mataro, 8 samples	.043
Gros Mansenc, 7 samples	.069	Marzemino, 3 samples	.040
Rothgipfler, 3 samples	.068	Zinfandel, 4 samples	.039
Cabernet Sauvignon, 9 samples	.065		

In this table we have the two well-known varieties, Chauché noir and Zinfandel, standing respectively at the two extremes, and the former containing nearly three times the amount of nitrogen found in the Zinfandel; their respective types also occupy the same relative position with respect to that grouping. The rest of the table speaks for itself in showing the average content and the relative position of the varieties with respect to nitrogen.

Differences between Individual Samples.—In this comparison the effect of varying climatic and soil conditions, as well as that of maturity, is shown in the very great differences not only between samples of different varieties, but in some cases between those of the same variety.

In glancing over the table as it stands we find at one extreme the Chauché noir, No. 1620, from Tulare, with the highest percentage of nitrogen in its must, viz., 0.188, while at the other extreme we find the Tannat and Marzemino, Nos. 1835 and 1231, with but 0.014%. In other words, the maximum of nitrogen is more than fourteen times greater than the minimum. In the entire list of 209 there are but 19 which have as much as 0.100% of nitrogen. As a matter of interest we place in order the ten highest and lowest respectively:

Highest in Nitrogen.			Lowest in Nitrogen.		
No. 1620.	Chauché noir	.188	No. 1525.	Carignane	.028
No. 1434.	Cinsaut	.177	No. 1230.	Robin noir	.026
No. 1446.	Chauché noir	.165	No. 1820.	Cabernet Sauvignon	.025
No. 1943.	Teinturier mâle	.141	No. 1284.	Chauché noir	.025
No. 1614.	Cinsaut	.140	No. 2174.	Mondeuse	.022
No. 1681.	Gros Verdot	.138	No. 1257.	Zinfandel	.021
No. 1302.	Tannat	.125	No. 1249.	Grenache	.020
No. 1298.	Chauché noir	.117	No. 1823.	Gamai Teinturier	.016
No. 1584.	Refosco	.112	No. 1231.	Marzemino	.014
No. 1332.	Pinot St. George	.110	No. 1835.	Tannat	.014

The table simply shows that while a sample such as the Chauché noir may stand highest in the amount of nitrogen in its must, another sample of the same variety is one of the other extremes. Evidently, other causes or conditions than mere variety influence the assimilation of nitrogen.

Seasonal Variations in Nitrogen.—There is naturally some variation in the amount of nitrogen absorbed from year to year by the same variety upon the same soil, and the extent of that variation for some of the varieties is shown in the following table:

TABLE SHOWING EXTREME SEASONAL VARIATIONS IN ONE AND THE SAME VARIETY.

No.	Variety.	Locality.	Vintage.	Nitrogen Per Cent.	Variation.
	Bordeaux Type.				
1113	Cabernet Sauvignon	Mission San José	1889	.097	.037
1342	Cabernet Sauvignon	Mission San José	1890	.060	
1554	Cabernet Sauvignon	Paso Robles	1891	.076	.014
1914	Cabernet Sauvignon	Paso Robles	1893	.062	
1443	St. Macaire	Tulare	1891	.079	.003
1846	St. Macaire	Tulare	1893	.076	
1296	St. Macaire	Mission San José	1890	.070	.015
1706	St. Macaire	Mission San José	1892	.055	
1560	Tannat	Paso Robles	1891	.079	.019
1911	Tannat	Paso Robles	1893	.060	
1489	Malbeck	Paso Robles	1891	.081	.004
1917	Malbeck	Paso Robles	1893	.077	
1547	Gros Mansenc	Paso Robles	1891	.063	.030
2083	Gros Mansenc	Paso Robles	1893	.093	
	Burgundy Type.				
1258	Pinot de Pernand	Mission San José	1890	.100	.003
1504	Pinot de Pernand	Mission San José	1893	.097	
1508	Pinot St. George	Mission San José	1891	.083	.013
1910	Pinot St. George	Mission San José	1893	.070	
1428	Robin noir	Mission San José	1890	.056	.006
1963	Robin noir	Mission San José	1893	.062	
1446	Chauché noir	Tulare	1891	.165	.023
1620	Chauché noir	Tulare	1892	.188	
1557	Chauché noir	Paso Robles	1891	.070	.009
1868	Chauché noir	Paso Robles	1892	.079	
	Southern French Type.				
1438	Serine	Tulare	1891	.103	.006
1814	Serine	Tulare	1893	.109	
1488	Serine	Paso Robles	1891	.072	.017
1895	Serine	Paso Robles	1893	.089	
1151	Mondeuse	Cupertino	1889	.080	.028
1812	Mondeuse	Cupertino	1890	.052	
1142	Mondeuse	Mission San José	1889	.088	.017
1334	Mondeuse	Mission San José	1890	.071	
1447	Carignane	Tulare	1891	.058	.017
1628	Carignane	Tulare	1892	.065	
1887	Carignane	Tulare	1893	.075	
1527	Grenache	Paso Robles	1891	.070	.020
1721	Grenache	Paso Robles	1892	.050	
1529	Petit Bouschet	Paso Robles	1891	.091	.012
2009	Petit Bouschet	Paso Robles	1893	.079	
1436	Aramon	Tulare	1891	.055	.006
1639	Aramon	Tulare	1892	.061	

TABLE. SHOWING EXTREME SEASONAL VARIATIONS IN ONE AND THE SAME VARIETY—Continued.

No.	Variety.	Locality.	Vintage.	Nitrogen Per Cent.	Variation.
	North Italian Type.				
1445	Barbera	Tulare	1891	.094	.019
1675	Barbera	Tulare	1892	.075	
1554	Nebbiolo, or Spanna	Paso Robles	1891	.067	.018
1954	Nebbiolo, or Spanna	Paso Robles	1893	.085	
1958	Nebbiolo, or Spanna	Paso Robles	1893	.074	
1437	Crabb's Black Burgundy.	Tulare	1891	.081	.007
1615	Crabb's Black Burgundy.	Tulare	1892	.088	
	Hungarian Type.				
1071	Zinfandel	Amador station	1889	.043	.022
1257	Zinfandel	Amador station	1890	.021	
1440	Blue Portuguese	Tulare	1891	.104	.014
1618	Blue Portuguese	Tulare	1892	.090	

About four fifths of the varieties of musts just tabulated above show, for different seasons, very little variation in nitrogen percentage. The greatest variation occurs in the Cabernet Sauvignon—0.037% difference between the seasons of 1889 and 1890, grown at Mission San José. The Gros Mansenc shows the next largest difference—0.030% for the years 1891 and 1893, at Paso Robles. The smallest difference—0.003%—is shown in the St. Macaire of the years 1891 and 1893, from Tulare:

Regional Variations.—In preparing the following table, showing the results by regions, we have taken an average of the figures for nitrogen in must recorded in the large table (A) above, where more than one analysis occurred for one locality. In order to show the differences between musts of the same varieties of grapes grown on different soils in localities differing climatically, we have tabulated the nitrogen results according to the *agricultural regions*. These regions are fully described in the Reports of 1888-89 and 1892 of this station; and that part of the description relating to climate and soil is, in part, given here in the following quotations:

"The *Bay region* constitutes a climatic as well as a hydrographic and topographic feature; for, insignificant as the break formed by the Golden Gate may seem, it modifies profoundly the climate of the country lying adjacent and opposite to it, not only by the influence of its cool tide-water, but as well by the corresponding cool lower air-currents sweeping through it almost throughout the season, and carrying with them both the temperature and the moisture of the ocean, both modified by the cold Alaskan current. In summer, the river of fog, a mile wide, may be seen flowing in steadily through the Gate in the afternoon, first submerging the City of San Francisco, and then broadening and sending off branches right and left, up and down the bay, and toward the evening reaching the opposite shore where the Contra Costa range forms a barrier for a time. * * * The direct influence of this current extends about ten miles each way on the opposite shore, causing an exceptionally low summer temperature, which fails to ripen the grape and fig. Mission San José is located outside of this fog district on the east side.

"On the western shore of the bay the high ranges of the immediate coast form a barrier not surmounted by a considerable portion of the summer fogs; under the lee of these a warmer summer temperature prevails on the bay shore slopes. Cupertino is located on this part, and thus does not wholly lie without the fog-influenced district of the west side of San Francisco Bay.

"The *Southern Coast Range Valley region* is represented by the Paso Robles station, on the east side of the main Coast Range, outside the fog belt of the coast region, at an elevation of nearly 1,000 feet. This locality represents one of great fluctuation in temperatures (for the year 1892–93 the mean daily range in temperature was 30.18°). The atmosphere is dry, but owing to altitude the rainfall is greater (about 14 inches against 6 inches), and the average temperature lower than in adjacent portions of the great valley.

"The division of the *Great Valley region* traversed by the San Joaquin River constitutes about three fifths of the whole. The climate of the San Joaquin Valley stands in marked contrast to that of the immediate coast of California, and most markedly with that of the bay region contiguous to the Golden Gate. A very light rainfall, a very dry atmosphere, especially in summer (mostly below 50% of saturation), and a summer temperature which by the thermometer is very high, but which, in consequence of the dryness of the air, is but rarely oppressive, constitute the main factors of the climate of the interior valley.

"The climate of the *Sierra Foothill region* may be roughly said to be similar, as to temperature, to that of the adjacent portion of the Great Valley up to about 1,500 feet in its northern, and up to 2,000, and even more, in the southern part. Here, as in the valley, snow lies in the winter only for a few hours, or days, if it falls at all, and the fig and citrus fruits flourish. The summers are warm, the temperature very commonly rising into the nineties in the daytime; but, owing to the dryness of the air, this temperature is not oppressive, the more as the nights are always cool."

Nitrogen Contents of the Soils of the Several Regions.—Nitrogen occurs in soils in several combinations: in the humus in organic form, in the nitrates, and in the ammonia and ammoniacal salts. The soils of the several regions have been examined for nitrogen by this Station,[*] with results as shown in the following table:

NITROGEN IN SOILS OF VARIOUS REGIONS.

Region.		Humus Nitrogen, per cent on Soil.	Sodium Nitrate, ready-formed.
Sierra Foothills	Amador County, slate soil	0.090	------
	Amador County, granitic soil	0.100	------
Great Valley	Fresno, granitic soil	0.112	------
	Tulare, light sandy soil	0.062	0.067
Bay	Mission San José, heavy calcareous adobe soil	0.088	------
	Cupertino, gravelly clay loam soil	0.067	------
Southern Coast Range Valley	Paso Robles, sandy loam soil	0.100	------

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[*] "On the Nitrogen Contents of Soil Humus in the Arid and Humid Regions," by E. W. Hilgard and M. E. Jaffa, Report of Agricultural Experiment Stations, California, 1892–93–94, page 66. The nitrogen in the Cupertino soil has recently been determined by R. A. Gould, of the Agricultural Laboratory

Thus, the soils upon which the grapes under consideration were grown show some differences in soil nitrogen, especially that part contained in the organic form—that is, in the humus. The soils from Amador, Fresno, Paso Robles, and Mission San José all carry in the neighborhood of 0.100% of organic nitrogen. Those of Cupertino and Tulare resemble each other in this respect, having upward of 0.060% of organic nitrogen. But the Tulare soil possesses, in addition to its organic nitrogen, a supplement of nitrogen in the form of sodium nitrate (0.067% equivalent to 0.011% of nitrogen), wherein it differs from the soils of all the other regions. The introduction of the subject of soil nitrogen at this point is not, of course, to enforce any hard and fast rules relating to its influence upon grapes, because the data are insufficient and the whole subject is, as yet, a study.

TABLE B.—DIFFERENCES IN NITROGEN BETWEEN MUSTS FROM THE SAME VARIETIES OF GRAPES GROWN IN DIFFERENT REGIONS.

VARIETIES.	Foothills Region.	Great Valley Region.		Bay Region.			Coast Range Valley Region.
	Amador Co.	Fresno.	Tulare.	East Side, Mission San José.	West Side, Cupertino.	Napa Valley, Asti.	Paso Robles.
Bordeaux Type.							
Cabernet Sauvignon	.025	.036	.071	.077	.082		.069
Cabernet Franc				.088	.042		.080
Gros Verdot		.059	.138	.098	.041		.091
Malbeck	.037	.063	.070	.092	.053		.079
Tannat	.014		.041	.125	.037		.070
Teinturier mâle	.064	.063	.141	.102	.066		.092
Gamai Teinturier	.016	.039	.089	.080	.047		.082
St. Macaire	.041		.077	.063	.056		
Burgundy Type.							
Pinot de Pernand		.101	.094	.098	.067		.074
Pinot St. George	.040	.083	.057	.076	.110		.067
Meunier	.043	.060	.063	.087	.043		.047
Chauché noir	.030		.176	.117	.065		.074
Robin noir	.033	.026	.045	.059	.025		.104
Southern French Type.							
Petite Sirah					.065		.085
Serine	.051	.055	.106	.088	.061		.081
Mondeuse	.022		.056	.079	.066		.068
Cinsaut	.044		.155	.095	.056		.077
Mataro	.040	.035	.042	.029	.049		.076
Carignane	.032	.026	.066	.100	.050		.049
Grenache	.032	.020	.064		.053		.060
Petit Bouschet		.097	.060	.100	.094		.079
Aramon	.040	.035	.058	.081	.060		.055
César						.072	
Austrian and Hungarian Type.							
Zinfandel	.032	.045					
Blue Portuguese		.057	.097	.087	.061		.077
Rothgipfler	.065			.063			.077
Marzemino		.014		.042	.065		

TABLE B.—Differences in Nitrogen between Musts from the Same Varieties of Grapes Grown in Different Regions.—Continued.

VARIETIES.	Foothills Region.	Great Valley Region.		Bay Region.			Coast Range Valley Region.
	Amador Co.	Fresno.	Tulare.	East Side, Mission San José.	West Side, Cupertino.	Napa Valley, Asti.	Paso Robles.
Austrian and Hungarian Type—Continued.							
Grüner Velteliner		.041		.075	.047		
Kadarkas		.064		.107	.071		
North Italian Type.							
Gros Mansenc	.034	.050	.088	.087	.056		.079
Fresa	.034	.059	.049		.065		.086
Barbera			.084	.065	.085	.057	
Spanna, or Nebbiolo	.034				.042	.037	.078
Refosco				.112	.084		
Crabb's Black Burgundy		.081	.084	.091	.057	.042	.068
Dolcetto						.049	
Barolo						.064	
Bonarda			.071		.059		.079

A study of the figures in the table, as a whole, shows that the musts of grapes from Mission San José (Bay region) and Tulare (Great Valley) are the highest in nitrogen; those from Paso Robles in the Coast Range Valley stand second; those from Cupertino (on the west side of the Bay region) and those from Fresno (in the Great Valley) are-third, while those from Amador (of the Foothills region) are the lowest in nitrogen. This is shown in the following table:

Must.	Mission San José.	Tulare.	Paso Robles.	Cupertino.	Fresno.	Amador Station.
Gros Verdot....	.098	.138	.091	.041	.059	----
Tannat.........	.125	.041	.070	.037	----	.014
Chauché noir...	.117	.176	.074	.065	----	.030
Robin noir.....	.059	.045	.104	.025	.026	.033
Petite Sirah....	.088	.106	.081	.061	.055	.051
Aramon........	.081	.058	.055	.060	.035	.040
Blue Portuguese	.089	.097	.077	.061	.057	----

It is interesting to compare results between Mission San José and Cupertino, two points comparatively few miles from each other in the same valley or Bay region, but situated respectively on the east and west side, and which possess some climatic differences.

Of the thirty-two different varieties of musts analyzed from these places, those from Mission San José contain the highest percentage of nitrogen in all but five samples, viz.: Cabernet Sauvignon, Pinot St. George, Mataro, Marzemino, and Barbera. In many instances the percentage of nitrogen is twice, and sometimes three times, that found in the Cupertino samples.

It might be expected, too, that the Fresno soil, situated as it is in the hot climate, where nitrification is most intense, would yield musts containing at least as much nitrogen as those from Tulare, in the same region. But the figures do not bear this out. Tulare musts rank in nitrogen, in almost every variety, far above those from Fresno.

These differences cannot be explained by the facts heretofore given relating to the soil nitrogen, for we find that both the light, sandy soil of Tulare and the heavy adobe of Mission San José have relatively small amounts of soil nitrogen to produce grape musts which are richest in nitrogenous matters. The foothill granite soil, with quite as much soil nitrogen as either the loamy soil of the Coast Range valleys or the granite soil of Fresno, fails in nearly every case to produce musts which even approach in nitrogenous matters those of the above districts. The foothill station soil in other respects, too, gives rather poor results with grape-varieties. The soil seems to be too dry to give good crops. From these facts before us, it seems that the nitrogen withdrawn by grapes and held in their musts does not stand in any direct relation to the total of the nitrogen contained in the soil itself.

European Analyses.—Some nitrogen determinations in musts from grapes grown in Europe have come under our observation. We give below part of the results obtained from those grown at the St. Michele Experiment Station, in Austria, and reported in "Landw. Versuchs. Stationen Nos. 36 and 41, Über den Gehalt an stickstoffhaltigen Substanzen in Trauben aus dem Anstaltsgute in St. Michele," by E. Mach and K. Portele.

NITROGEN IN EUROPEAN AND CALIFORNIA MUSTS.

	Vintage.	*Austrian Musts.	California Musts.
		Nitrogen Per Cent.	Nitrogen Per Cent (Average).
Cabernet Sauvignon	1891	.049	----
Cabernet Sauvignon	1889	.049	----
Cabernet Sauvignon	1889	.060	.065
Carbernet Franc	1889	.063	.070
Cabernet Franc	1888	.046	----
Merlot	1889	.037	----
Blauer Burgunder (Pinots)	----	.056	.081
Kadarkas	1889	.045	----
Kadarkas	1888	.027	.080
Lagrain	1889	.056	----
Lagrain	1888	.036	----

*Landw. Versuchs. Stationen (No. 41, 1892).

It will, of course, be borne in mind that the California grapes were not fertilized, while those at the Austrian station were, though perhaps not more than would offset the natural richness of our soils. Still, the Austrian varieties hardly show, on the whole, as much nitrogen as do our California musts. We notice, however, in the work referred to, that some of the Eastern American grapes grown at St. Michele yield some pretty high nitrogen percentages; namely, Jacquez (Lenoir), with 0.081%, and Herbemont, with 0.091%.

EXAMINATION OF THE WINES.

Of the one hundred and thirteen wines studied for this investigation and shown in Table A, quite one hundred were made in the viticultural cellar at this station; the remainder are marked as sent for examination. These station wines were all analyzed at the same age—from four to six months from making, or after being racked the second or third time. Their condition at that age, as recorded in this and previous viticultural reports, was generally *good*, the wines being bright, *i. e.*, having become cleared.

Nitrogen in Wines—Differences between Different Types.—The following table shows how the wines of the different types compare in their averages in nitrogen contents. Alongside of these we give the figures for the corresponding musts:

Type.	WINE.		MUST.		Nitrogen Lost during Fermentation. Per Cent.
	Number of Analyses.	Nitrogen Per Cent.	Number of Analyses.	Nitrogen Per Cent.	
Bordeaux	36	0.043	55	0.070	38.50
Burgundy	7	0.044	33	0.072	38.80
Southern French	44	0.037	61	0.064	42.20
Northern Italian	15	0.037	34	0.066	43.60
Austrian and Hungarian	11	0.036	22	0.060	40.00

The Bordeaux and Burgundy types of wines lead, as do their musts, in nitrogen. The other types—Southern French, North Italian, and Hungarian—show small differences between themselves, and here, again, they resemble their corresponding musts.

Differences between Varieties.—Comparing the averages of the varieties we find the Cinsaut, with its 0.090%, and the Chauché noir, with 0.071%, to rate highest, as is shown in the following table, in which nine of each extreme are given:

HIGHEST.			LOWEST.		
Variety.	Wine.	Must.	Variety.	Wine.	Must.
Cinsaut	.090	.132	Bonarda	.033	.063
Chauché noir	.071	.128	Aramon	.029	.059
Refosco	.056	.112	Grenache	.028	.043
Cabernet Sauvignon	.056	.073	Dolcetto	.027	.049
Gamai Teinturier	.055	.069	Zinfandel	.026	.039
Kadarkas	.054	.089	Pinot St. George	.026	.055
Nebbiolo or Spanna	.052	.085	Carignane	.025	.053
Petite Sirah	.052	------	Velteliner	.021	.058
Pinot de Pernand	.050	.100	Mataro	.017	.041

It is worthy of note that in the vinification, the Cinsaut lost camparatively little of its nitrogen, while the Chauché noir lost one third, and the Refosco still more. In the varieties with low nitrogen percentages the proportionate loss is still greater in some instances. Thus, the Grüner Velteliner and the Carignane have fallen more than one half, while of the Pinot St. George but one third of the original remains.

Differences between Individual Wines.—It does not follow, as a matter of fact, that the musts that contain the highest amount of nitrogen would give a wine which also ranks highest in the same; for the loss in vinification is unequal for the different samples. This is shown in the following table, in which ten samples at each extreme of nitrogen percentages have been compiled from the large general table first given:

HIGHEST.			LOWEST.		
Variety.	Wine.	Must.	Variety.	Wine.	Must.
No. 1434. Cinsaut	.124	.171	No. 1243. Gros Mansenc	.016	.050
No. 1620. Chauché noir	.105	.188	No. 1189. Aramon	.015	------
No. 1614. Cinsaut	.093	.140	No. 1255. Mataro	.015	.036
No. 1113. Cabernet Sauvignon	.089	.097	No. 1253. Zinfandel	.015	.030
No. 1418. Kadarkas	.076	.107	No. 1257. Zinfandel	.013	.021
No. 1497. Teinturier mâle	.074	.092	No. 1252. Mataro	.011	.035
No. 1142. Mondeuse	.073	.088	No. 1246. Aramon	.011	.035
No. 1302. Tannat	.068	.125	No. 1189. Aramon	.010	------
No. 1814. Serine	.067	.109	No. 1525. Carignane	.010	.026
No. 1618. Blue Portuguese	.067	.090	No. 1251. Carignane	.007	.026

The difference between the two extremes represented by Cinsaut and Carignane, respectively, is very great, the latter having but about one eighteenth as much nitrogen as the former. The great majority of the one hundred and thirteen samples of wines examined contain less than 0.050% of nitrogen.

Variations by Seasons.—It is interesting to note the differences in nitrogen contents that occur in wines from grapes of the same variety grown on the same plot in two consecutive seasons, and for convenience of comparison some of these are presented in the following table:

NITROGEN OF SOME VARIETIES OF WINE FROM GRAPES GROWN ON SAME PLOT IN DIFFERENT YEARS.

No.	Variety.	Locality.	Vintage.	Nitrogen Per Cent.	Variation.
1113	Cabernet Sauvignon	Mission San José	1889	.089	.047
1342	Cabernet Sauvignon	Mission San José	1890	.042	
1295	St. Macaire	Mission San José	1890	.023	.003
1706	St. Macaire	Mission San José	1892	.026	
1058	Gamai Teinturier	Mission San José	1889	.049	.005
1294	Gamai Teinturier	Mission San José	1890	.044	
1042	Serine	Fresno	1889	.044	.017
1242	Serine	Fresno	1890	.027	
1151	Mondeuse	Cupertino	1889	.056	.040
1312	Mondeuse	Cupertino	1890	.016	
1142	Mondeuse	Mission San José	1889	.073	.045
1334	Mondeuse	Mission San José	1890	.028	
1069	Mataro	Amador station	1889	.021	.006
1255	Mataro	Amador station	1890	.015	
1628	Carignane	Tulare	1892	.031	.004
1887	Carignane	Tulare	1893	.035	
1189	Aramon	Cupertino	1889	.015	.018
1414	Aramon	Cupertino	1890	.033	
1175	Aramon	Mission San José	1889	.042	.004
1377	Aramon	Mission San José	1890	.046	
1071	Zinfandel	Amador station	1889	.028	.015
1257	Zinfandel	Amador station	1890	.013	
1098	Zinfandel	Fresno	1889	.047	.032
1253	Zinfandel	Fresno	1890	.015	

As with the musts, so we find with the wines that the variations in nitrogen between two seasons for the same grape is in some cases very great and in others quite small. This is most noticeable in the Aramon, which at Cupertino differed by 0.018% for the seasons of 1889 and 1890, while at Mission San José for the same seasons the difference was only 0.004% of nitrogen. The Mondeuse, on the contrary, shows about equal differences (0.040% and 0.045%) for each of those localities. The Zinfandel also has a greater variation at Fresno than at Amador.

Effect of Nitrogen on the Keeping Quality of Wines.—The wines reported in the tables above were all made in the same manner; namely, by fermentation in open tanks, but covered with a floating cover and stirred twice a day, the outside temperature being kept at 75° F. We have already noted the differences between the different types of wines and their corresponding musts, but without reference to the *keeping qualities* of the wines. The types, from records here, when considered from the latter point of view, may be classified again: Bordeaux, *good keepers*; Burgundy, *not very good*; Southern French, *only fair*, on the whole; North Italian, *keeps very well*, as far as known; and the Hungarian, *rather well*. We find that the Bordeaux and Burgundy wines, which represent the extremes of both good and poor keepers, have in vinification each retained the largest part of their original nitrogenous matters. While the other types, viz.: Southern French, North Italian, and Hungarian, which are better than the Burgundy, have also retained about the same amount of their original nitrogen.

Among the *varieties* the Cinsaut, 0.090%, and Chauché noir, 0.071% of nitrogen, which are not rated as good keepers, average the highest in nitrogen-holding power, although having lost respectively 31.8% and 44.0% of their initial nitrogen.

The Cabernet Sauvignon, Refosco, Gamai Teinturier, and Spanna, with next highest nitrogen content, are all good keepers; the Petite Sirah, an exception to its type in being a good keeper, ranks with these in its nitrogen.

Of the wines retaining 0.050% of nitrogen (corresponding to 0.312% of albuminoids), the poor keepers are predominant, as represented by Pinot de Pernand, Robin noir, Serine, Petit Bouschet; and the Teinturier mâle, Verdot, and Tannats representing the better class.

The low nitrogen-holding varieties of wine (averages) are easily seen to be mostly in the class of wines with poor keeping qualities, as represented by the Pinot St. George, Carignane, and Grenache; however, the Zinfandels, good keepers, come in just at this point.

Of the *individual samples* we find that both the highest and the lowest nitrogen-holders belong to the class of wines of poor keeping qualities: The Cinsaut, No. 1434, retained 0.124% of nitrogen or 0.758% of albuminoids; the Chauché noir, No. 1620, 0.105% of nitrogen, corresponding to 0.656% of albuminoids. These have about ten times more albuminoids than the Carignane (Nos. 1251 and 1525), Mataro (No. 1252), Aramon (Nos. 1246 and 1189), and Pinot St. George (No. 1819), all with 0.010% of nitrogen or 0.063% of albuminoids; these, too, are poor keepers, or hard to keep until full maturity without special precautions. No. 1312, Mondeuse, with 0.016% of nitrogen or 0.100% of albuminoids, is an exception to its type, in being a good keeper; No. 1243, Gros Mansenc, with the same amount of nitrogen, keeps well also.

The large number of wines intermediate between the extremes just discussed are quite evenly distributed between good and only fair keepers; occasion to study them more fully will be taken when we refer to the influence of locality upon their nitrogen contents.

From the foregoing we are able to emphasize our first conclusion: that the inference is rather against the significance of the *amount* of nitrogen present as controlling the keeping qualities of wines. This is shown especially in samples of the Mondeuse, which, in 1889, had a high content of nitrogen, and in 1890 a very low percentage, and yet their records show that they were in each case both very fair keepers. The influence, so far as it goes, probably lies more in the direction of the *quality* than of the *quantity* of nitrogenous ingredients.

Influence of Locality.—For the purpose of considering the influence of locality upon the nitrogen held in wines of the same and different varieties, we group them according to regions in the accompanying large table, which shows the nitrogen per cent in the must and the wine, and the differences between the must and the wine expressed in figures for absolute amount, and per cent upon original nitrogenous contents.

The differences in the nitrogenous matters of the musts and wines for localities may, for convenience, be stated in this general way, from the results shown by the table: The wines of the Foothills region (average of 6 samples) have lost 50% during fermentation, those of the Valley (average of 27) 41.90%, of the Bay (average of 44) 46.80%, and of the Coast (average of 15) 43.60% of their initial nitrogen. However, as these figures relating to wine are based upon extremely variable results for the different regions, even the differences between the same wines grown in any one locality are notable, so that it becomes quite necessary to examine some of the results carefully.

Take, for instance, the Teinturier mâle from the three greater districts; we find the Coast sample of wine, No. 1497, to have been deprived of 19.50% of its original nitrogen during fermentation, as against 43.20% for the Bay wine, No. 1292, and 54.10% for the Valley wine, No. 1205.

The Gros Mansenc of the three regions, on the whole, offers an example of rather similar figures in loss of nitrogenous matters, viz.: Valley, 56%; Bay, 53%; Coast, nearly 48%. The Chauché noirs from Bay and Coast Range valleys have parted with rather more nitrogen than the Valley wine, for they show a little over 50% loss as against 44.10%; the must of the Chauché noir of the Valley contained 0.108% of nitrogen, that from the Bay 0.117%, and that from the Coast Range valleys 0.079%—all high quantities.

The Serine wines of the various localities are rather constant than otherwise in loss of nitrogenous matters, as witness: Coast, 42.50%; Bay, 46.90%; and Valley, average, 45.0%—with quite similar and high amounts in their musts.

The Mondeuse wines from the Bay region are very erratic, losing all the way from 17% to 60% of nitrogenous matters, but averaging about 50%, as against 57% for the Valley and 47% for the Coast Range valleys.

The Mataros, with the exception of those of the Coast Range valleys, began fermentation with quite similar amounts of nitrogenous matters, and yielded, in the end, wines with some variations for the separate regions; the Foothill and Bay musts have lost about 56%, the Valley and Coast, each upward of 69%.

Of the Aramons, the Valley samples of wine have lost the largest amount of nitrogenous matters during fermentation, averaging over 57% loss; the Bay and Coast lots have retained more of the ingredients, having lost, respectively, 43.30% and 45%. Crabb's Black Burgundy (Refosco) shows the Coast wine to hold much more nitrogenous matter than the Bay or Valley wines of this name; and we may call attention to the fact that the Bay district presents rather wide ranges in nitrogen of musts, and also in amount of nitrogen retained after fermentation.

The Zinfandel wines from the Valley differ greatly in nitrogen eliminated during fermentation, No. 1098 having lost about one fourth and No. 1253 just one half; the Foothill wines, on the other hand, show more uniform loss, and average 36.70% loss.

Thus it appears that in carrying this work forward we have found

abundant examples to verify the earlier statements in regard to the influence of climate and soil upon the nitrogen contained in grape musts, viz.: "that while climate exerts a material influence upon the nitrogen contents of all grape musts, and especially upon the loss of nitrogen in vinification, a very great influence must also be ascribed to the soil, although the differences are not equal, or proportional, in different grape-varieties. It does not appear that the total amount of nitrogen present in grape musts bears any direct relation to the known keeping qualities of the wines, whether we compare different varieties, or the same variety from different localities." And until we have determined in what condition the nitrogen exists in wines, it is impossible to specify the influence, if any exists, that nitrogenous matters have upon the conservation of wines. The subject is an exceedingly complicated one, because, as yet, there is no reliable method for the separation of the various nitrogenous bodies known as "albuminoids," peptones, amides, etc.

THE INFLUENCE OF DIFFERENT METHODS OF VINIFICATION UPON THE NITROGENOUS CONTENTS OF WINES.

This is illustrated in the results given in the following table. These experiments, an account of which was published separately in 1888 (see "Report of Experiments on Methods of Fermentation"), showed amazing differences in composition as the result of varying the methods of vinification. Without entering upon the details of these methods, some salient points may be mentioned.

The material employed was Carignane grapes from Mission San José, Alameda County, the locality which in the preceding discussion has been found to produce wines so exceptionally rich in nitrogenous compounds. It did not belie its reputation with the Carignane used, which, when vinified according to our usual method (in open tank with floating cover and twice-daily stirring, and outside temperature of 75° F.), showed 0.081% of nitrogen against 0.011% found in the wine of the same grape grown in Amador County—an enormous difference.

TABLE D.

DETERMINATION OF NITROGEN (*Resp.* "ALBUMINOIDS") IN WINES (CARIGNANE, AGE 2½ YEARS) FROM EXPERIMENTAL FERMENTATIONS, VINTAGE OF 1887.*

Number.	Mode of Fermentation.		Nitrogen.	"Albuminoids."
			(March, 1890.)	
795	Floating cover, twice-daily stirring, 90°-95° F.		.098	.613
787	Floating cover, twice-daily stirring	72°-75° F.	.081	.508
788	Single frame, near top of mash		.099	.619
789	Single frame, near middle of mash		.102	.638
790	Single frame, pumping over the wine from below		.085	.531
791	Three frames, at different heights		.095	.594
792	No cover, twice-daily stirring		.096	.600
793	No cover, stirring by pumping air		.077	.481
794	"Morel process" (whole grapes)		.088	.551
796	Floating cover, twice-daily stirring, 62° F.		.097	.606

*See Report on "Experimental Fermentations," 1888.

The maximum of nitrogen (0.102%) was found in the wine made according to the somewhat laborious, but thoroughly rational, method of keeping the pomace-cap submerged far below the surface of the liquid (No. 789), preventing acetification, and producing a wine of markedly good character, both as to bouquet, softness, and keeping qualities. The minimum (0.077%) was obtained when employing a rather excessive amount of aëration, by not only leaving the surface of the wine exposed, but also pumping air through it thrice daily, instead of stirring with the usual implement (No. 793). That this aëration brings about a precipitation of nitrogenous substances has been known ever since the experiments on the D'Heureuse method of defecating vegetable juices, and was to be expected in this case. But owing to the excessive exposure to the air, the wine so prepared of course did not keep well.

The relative effect of *lack of aëration* is shown also in the result of the process (No. 788), in which a single grated frame is made to hold the pomace-cap near the surface of the liquid, although submerged; no stirring being done, and therefore no aëration beyond what occurs at the surface, where the small amount of fluid retained there usually becomes acetified. Its nitrogen percentage (0.099) is greater by 0.018 than that of the wine made by our usual process (No. 787), which received a moderate amount of aëration by stirring.

The most unexpected result shown in the table is that of the fermentation at the high temperature of 90° to 95° F., which gave to the resulting wine the same amount of nitrogenous matter as the one conducted, otherwise similarly, but at the temperature of only 62° F. It has been thought that the higher temperature might tend to the dissolution of more albuminoids, and that this might have some connection with the poor keeping qualities of the wines produced, under the influence of heat, in warm climates; but this experiment seems to prove that this is not the case.

NITROGEN IN CALIFORNIA WINES OF MORE ADVANCED MATURITY THAN THE ABOVE.

Below, in the small table, is given the nitrogen contained in California wines exhibited at the World's Columbian Exposition, at Chicago; analyzed by Mr. W. H. Krug, of the U. S. Agricultural Department, Chemistry Division, Washington, D. C.:

Nitrogen in Older California Wines.

Wine.	Nitrogen.		"Albuminoids."	
	Maximum.	Minimum.	Maximum.	Minimum.
Zinfandel	0.084%	0.028%	0.525%	0.175%
Clarets	0.093	0.027	0.580	0.169
Cabernet	0.081	0.030	0.506	0.188
Malbeck	0.091	0.048	0.556	0.030
Medoc	0.058	0.039	0.363	0.238
Burgundy	0.074	0.030	0.450	0.188
Mataro	0.093	0.025	0.581	0.156
Barbera	0.032		0.200	
Barolo	0.014		0.094	
Mondeuse	0.034		0.213	

No accurate comparison, on account of differences of age, can be made between these results and most of those in Table A. However, the results for the older wines show, like the very young ones, wide differences in their nitrogen. The Cabernets from Gubserville, noted elsewhere as exceptions in point of age, are comparable with those analyzed by Mr. Krug. In the series embracing 1632R to 1635R, Table A, the nitrogen varies from 0.035% to 0.057%, as against 0.030% to 0.081% for those examined in Washington, from various California localities.

Taking the oldest Cabernet wines, vintage of 1885, of both series examined for nitrogen, we find for that from Gubserville 0.041%, as against 0.037% of nitrogen in that from Napa, No. 12762 of the analysis by Mr. Krug.

NITROGEN IN SOME EUROPEAN WINES.

The following list comprises some of the determinations of nitrogen in wine of various European sources. Selection has been made with a view to comprehend some similarity of *type* and *variety* between these and the California wines examined. But, on account of great difference in age of the wines examined, the comparisons we can make are necessarily not very accurate.

NITROGEN IN SOME EUROPEAN WINES.

Name and Source of Wine.		Nitrogen Per Cent.
***French Wines.**		
Grand wines	Côtes rôties	.042
	Pouilly	.081
	Pomard	.050
	Pomard	.074
	Beaune	.054
	Closvougeot	.080
	Richebourg	.052
	Nuits Saint George	.127
	Nuits Saint George	.124
	Nuits Saint George	.106
Common wines	Alicante	.016
	Narbonne	.009
	Gamai Beaune	.024
	Bouschet Mouvèdre d'Arles	.001
	Aramon (Arles)	.001
	Carignane (Arles)	.001
	Carignane (Arles)	.003
	Carignane (Arles)	.001
	Petit Bouschet (Arles)	.001
	Alicante Bouschet	.001

Name and Source of Wine.		Nitrogen Per Cent.
†*Italian Wines.*		
Nebbiolo		.011
Nebbiolo		.012
Bonarda		.017
Dolcetto		.010
Dolcetto		.017
Dolcetto		.013
Pinot		.001
Barbera		.007
Barbera		.014
Barbera		.017
Barbera		.020
§*Tyrol Wines*	maximum	.030
	minimum	.012
§*Lower Austria Wines*	maximum	.030
	minimum	.023
§*Dalmatia Wines*	maximum	.030
	minimum	.011
§*Hungarian Wines*	maximum	.045
	minimum	.010
‡*Austrian Wines.*		
Cabernet		.016
Kadarkas		.017
Marzemino		.018

*From "Étude sur la fermentation alcoolique du vin," par V. Martinand; Marseilles, 1893.

†"Ministero di Agricoltura, Industria E Commercio"; Italy; Report of 1896.

§Appendix B, Report of State Viticultural Commission, 1893–94. (Extracts from Report U. S. Dept. of Agr., Washington.)

‡Landw. Versuchs. Stationen, No. 36, 1889.

The French wines designated as *Grand Wines* by V. Martinand all carry high nitrogen percentages, while those named by him *Common Wines* are all low in that respect. The latter class seem to resemble, in low nitrogen contents, the wines of Austria and Italy, as given above.

As far as it is possible to compare the figures just above for the European wines with those in Table A, we can say that, with the exception of the high-grade French wines, the nitrogen of the California wines seems to be much higher, on the whole, than that contained in wines produced in the eastern and southern grape-growing regions of Europe. In northern Europe, too, this seems to hold, for the nitrogen, as far as observed, ranges from 0.010% to near 0.030%.

SUMMARY.

(*a*) *Musts.*—(1) The variation in average amount of nitrogen in the musts of the various types is confined to very narrow limits. (2) The *maximum* amount of nitrogen in the series of musts examined is over fourteen times greater than the *minimum*, or 0.188% as against 0.014% of nitrogen. (3) The greater part of the musts from grapes grown on the same plots, in different years, take up nearly the same amount of nitrogen each year. (4) The grapes from Tulare in the Great Valley, and from Mission San José of the Bay region, contain in their musts the highest nitrogen; the Coast Range Valley (Paso Robles) musts stand next; the Sierra Foothills musts are lowest, while Fresno (Valley) and Cupertino (Bay) musts stand intermediate between these and the Coast Range Valley. (5) The nitrogen withdrawn from the soil by grapes and held in their musts does not stand in any direct relation to the available *soil* nitrogen.

(*b*) *Wines.*—(1) The highest nitrogen averages in wines are found in the Bordeaux and Burgundy types as given. The other types examined contained, on the average, somewhat less than these, but resemble each other greatly. (2) Wines from the same grapes grown on the same plots in different seasons do not, on the whole, show much similarity in nitrogen. (3) The *maximum* amount of nitrogen found in wine is 0.124%, and the *minimum* was 0.007%. (4) The inference is rather against the significance of the amount of nitrogen present as controlling the keeping qualities of the wine. The influence, as far as it goes, probably lies more in the direction of the quality than of the quantity of the nitrogenous matters.

General Conclusions.—While the climate exerts a very great influence upon the nitrogen contents of all grape-musts, and especially upon the loss of nitrogen during vinification, a very great influence must also be ascribed to the soil; although the differences are not equal, or proportional, in different grape-varieties. It does not appear that the total amount of nitrogen present in grape-must bears any direct relation to the known keeping qualities of the wines, whether we compare different varieties or the same variety from different localities; and, until we have determined in what condition the nitrogen exists in the wine, it is impossible to define the influence, if any exists, that nitrogenous matters have upon the conservation or quality of wines. The subject is an exceedingly complicated one, because, as yet, there is no reliable method for the separation of the various nitrogenous bodies known as "albuminoids."

In those wines that show very wide differences in nitrogen contents in musts and wines there is probably a larger proportion of "albuminoids," while those with proportionately small amounts may be supposed to contain chiefly amido and imido compounds.

MISCELLANEOUS NOTES.

By F. T. Bioletti.

PRESERVATION OF FRESH GRAPES.

For four months in the year grapes are plentiful and cheap in California; for the other eight they almost disappear from the market. It is, therefore, very desirable to find some inexpensive and practicable way of keeping fresh grapes for as much of these eight months as possible. If this could be done it would be very profitable, as grapes kept till late spring or summer would increase three-fold in value.

In keeping grapes for any length of time there are two main dangers to be avoided—*drying up* and *mold*. If the grapes shrivel from loss of moisture they lose their character of fresh grapes and resemble raisins. If they are attacked by mold they are lost. Grapes for keeping should be handled with the greatest care. They should not be touched by the hand at all. In picking they should be handled by taking hold of the stem and laying them on straw, not allowing any bunch to lie on another. Only perfect and preferably loose bunches should be taken, all defective or bruised berries being carefully removed with a pair of scissors. The reason for such great care in handling is that the skin of the berry cracks very easily at the junction of the pedicel. This crack is often so small that it would not be noticed without careful scrutiny, but it gives an opening for molds and yeasts to enter the grape. A few grapes may start a growth of mold that soon envelops the whole bunch. It is also very desirable to retain as much as possible of the bloom of the grapes, and to do this there must be the minimum possible amount of contact between them and the hands.

Certain tough-skinned grapes strongly attached to the pedicel may be kept without much difficulty till Christmas or the middle of January by simply hanging them up or laying them on straw in a fairly dry room of even and low temperature. By January, however, they become much shriveled. Some fleshy grapes, such as the Almeria or Tokay, do not show the effects of loss of water so quickly. By the Thomery method of keeping a piece of vine wood, attached to the bunch, in a vessel of water, the grapes may be kept several weeks longer. This method, however, is troublesome and expensive; the water must be kept disinfected by wood-charcoal, and the bunches gone over carefully very often to remove decaying berries.

The Spanish method of packing the grapes in cork-dust is excellent for very hard grapes, such as the Almeria, but does not do for more delicate varieties. On account of the expense of cork-dust, attempts have been made to use sawdust as a substitute. There are several strong objections to its use, however. Even the most odorless sawdust communicates a taste to grapes after a few months. The hygroscopic nature of sawdust is very much against its use, especially if it is fine. If too dry it extracts moisture from the grapes, and if moist it favors the growth of mold. A process of treatment invented by Mr. Shepard seems likely to overcome both these objections.

All these methods aim to protect the grapes from mold by surrounding them with a dry atmosphere, and all fail to keep any but the coarsest varieties for the full eight months, on account of the drying up of the moisture in the berries. Other methods have been tried, the leading principle of which is to keep the grapes in an atmosphere saturated with moisture, thus preventing all shrinkage, and to avoid mold by the use of a very low temperature or antiseptics. Sulphurous acid gas preserves the grapes from mold without injuring their appearance, except for a slight bleaching, but the grapes soon contract a sulphurous taste, besides having their natural one destroyed, thus rendering them uneatable. The use of an atmosphere saturated with alcohol fumes has been tried in France, it is said, with great success. According to experiments made here, however, it is hardly to be recommended. Finally, the use of carbonic acid gas has been tried. The last is the most promising, judging by the few experiments made here.

Experiments at this Station.—During the vintage of 1894 an attempt was made to preserve grapes in sawdust. The varieties experimented on were Napoleon, Zabalkanski, Huasco, Muscat of Alexandria, and Purple Cornichon from Tulare. Spruce sawdust was used, as having comparatively little taste. The sawdust was spread out in a thin layer and exposed to the sun until quite dry. It was then allowed to cool, and used to pack the grapes in the boxes at the vineyard. The packed grapes were then shipped to Berkeley, where they were allowed to remain in the same boxes. They arrived in perfect condition on November 1st. They all kept fairly well for a month; after this they commenced to decay or shrivel. At six weeks the Huasco and Muscat were all decayed. The Cornichon was less attacked by mold, but soon shriveled. The Napoleon and Zabalkanski kept best, but in two months none of them were in marketable condition. Even those which were not decayed had a slight mawkish taste due to the sawdust. The results, then, were inferior to those already obtained by keeping the grapes on straw or hung up on strings. This is partly owing to the impossibility of removing the decayed grapes before they infect the others.

In order to make a preliminary test of the relative merits of alcohol vapor, carbonic acid gas, and sulphurous fumes, the following experiments were made at the laboratory:

No. 1. A bunch each of Sultana, Gros Colman, and Verdal were hung up in a box made of a five-gallon coal-oil can. The grapes were received on September 30, 1895, from Tulare. They were washed with a spray of water and put immediately into the box. A small, wide-mouthed, two-ounce bottle of alcohol was put in the bottom of the box, which was hermetically sealed with paraffine. All the grapes kept their appearance perfectly for five months, only a few turning brown. At the end of nine months most of the white grapes had turned brown, but the Gros Colman looked as if they had been just picked from the vines. They all, however, tasted strongly of alcohol and somewhat of vinegar. Many of the Verdal berries had fallen off the bunch. There was no mold on any of them. The turning brown seems to have been caused by a small yeast or torula which enters the grapes at the junction with the pedicel.

No. 2. Four bunches of Black Prince and Mission grapes received from Tulare, September 30, 1895, were placed in a box similar to that used in experiment No. 1. The only difference of treatment was that the grapes were dipped in a weak solution of sulphurous acid before being hung up. The results were similar, except that fewer berries turned brown. They all, however, had acquired a strong taste of alcohol and vinegar, which made them unfit for eating. The appearance of the Mission grapes was particularly fine. At the end of nine months they looked as though just picked from the vine, being unshriveled and covered with bloom.

On November 2, 1895, another series of experiments was made. The grapes used were Pizzutello, Purple Cornichon, Flame Tokay, and Zabalkanski from Tulare. Five tin boxes were prepared in the same way as for the first two experiments, and a bunch of each variety placed in each box. The boxes were covered inside and out with a coating of paraffine to prevent rusting.

No. 3. The box was left open to the air as a control test. In nine days the Pizzutello grapes were turning brown and, with the Tokay, were becoming moldy. The Zabalkanski and Cornichon were still in good order. In twenty days all the grapes were moldy.

No. 4. Sulphur was burned in the box as soon as the grapes were put in, in order to sterilize them. The next day the box was filled with carbonic acid, and hermetically sealed. At nine and at twenty days all the grapes were good. At two months some of the gas had leaked out, but the grapes were all in good order and the box was refilled with carbonic acid. At the end of four months all the grapes appeared good, showing no sign of rotting or mold. They were as plump as when put in, showing no sign of cracking or shriveling. Even the delicate skin of the Pizzutello was uninjured. All of them, however, had acquired a strong taste of the paraffine with which the box was coated. At the end of nine months the grapes were still in the same condition, except that a few were becoming moldy on account of a small crack in the cover, through which mold spores had obtained entrance.

No. 5. This was a repetition of experiment No. 2, and gave the same results.

No. 6. After the grapes were put in the box, sulphur was burned beneath them and the box hermetically sealed. All the grapes were good at the end of twenty-two days, when a stream of sulphur fumes was drawn through the box. At the end of four months the grapes were all good, except that they had the same disagreeable taste of paraffine, which spoiled the grapes in experiment No. 4. At the end of nine months there was little change. The colored grapes were a little bleached and some of the white grapes had turned brown. The Cornichon and Tokay looked as well as when gathered, but the Pizzutello and Zabalkanski were inferior in appearance to those in the carbonic-gas experiment.

No. 7. This was identical with No. 4, except that a little alcohol and corrosive sublimate were placed at the bottom of the box. The results for the first four months were the same as in experiment No. 4, but after this the grapes became moldy, on account of a leak in the box.

ANALYSES OF MUST OF PRESERVED GRAPES, JUNE 29, 1896.

Name.		Sugar by Copper Test.	Acid as Tartaric.
Black Prince	Experiment No. 2	14.70%	0.99%
Mission	Experiment No. 2	13.30	0.68
Corinchon	Experiment No. 4	16.90	0.23
Corinchon	Experiment No. 6	17.90	0.26
Zabalkanski	Experiment No. 6	18.20	0.49
Pizzutello	Experiment No. 6	18.60	0.21
Flame Tokay	Experiment No. 6	19.90	0.25

These experiments, although in no case successful in preserving grapes in perfectly marketable condition, are very promising, and show that at least their appearance can be kept perfect. They show also the ease with which grapes, under the conditions of the experiments, take up odors, and the necessity of keeping them protected from anything that is liable to give them a bad flavor. It is for this reason that the use of carbonic acid gas will, in all probability, be preferable to the use of either alcohol or sulphur fumes. As may be seen from the above table of analyses, made by Mr. G. E. Colby, in experiments Nos. 4 and 6 the grapes had maintained their usual sugar and acid contents practically unchanged, showing that no appreciable effect had been caused by molds or yeasts. In experiment No. 2, however, there had been a notable decrease of sugar due to fermentation, and increase of acid due to acetic bacteria.

SUNSTROKE OF THE VINE.

At the beginning of August, 1895, complaints were received from Fresno that a large number of isolated vines were dying of some unknown disease. At the request of Mr. Owen, manager of the Butler estate, a visit was made to the vineyard and the trouble investigated.

In various parts of the tract, isolated vines were losing their leaves, the grapes were being destroyed by the sun, and in the worst cases the vines were killed. Mr. Owen, under the impression that the vines were attacked by some kind of mildew, had sprayed them with Bordeaux mixture, and believed that he had succeeded in arresting the evil; of this, however, no evidence could be seen.

The symptoms of the disease were the following: The leaves gradually, or sometimes rapidly, dried up and fell off, leaving the shoots exposed and allowing them to be killed by the sun. The vines first showed effects of the trouble in the early part of the summer, and some of those first attacked, though losing all their leaves, partly recovered and sent out new leaves. The leaves when first attacked often became spotted in a way somewhat resembling the Anaheim disease, but with the important difference that the line between the healthy tissue and the dead was clearly marked with little or no diseased tissue between. The appearance of the leaves is fairly well shown in the accompanying figure taken from a photograph.

The specimens of leaves and fruit brought to Berkeley were examined, but no sign of fungous parasites could be found. The trouble occurred equally in all parts of the vineyard on young and on old vines, but

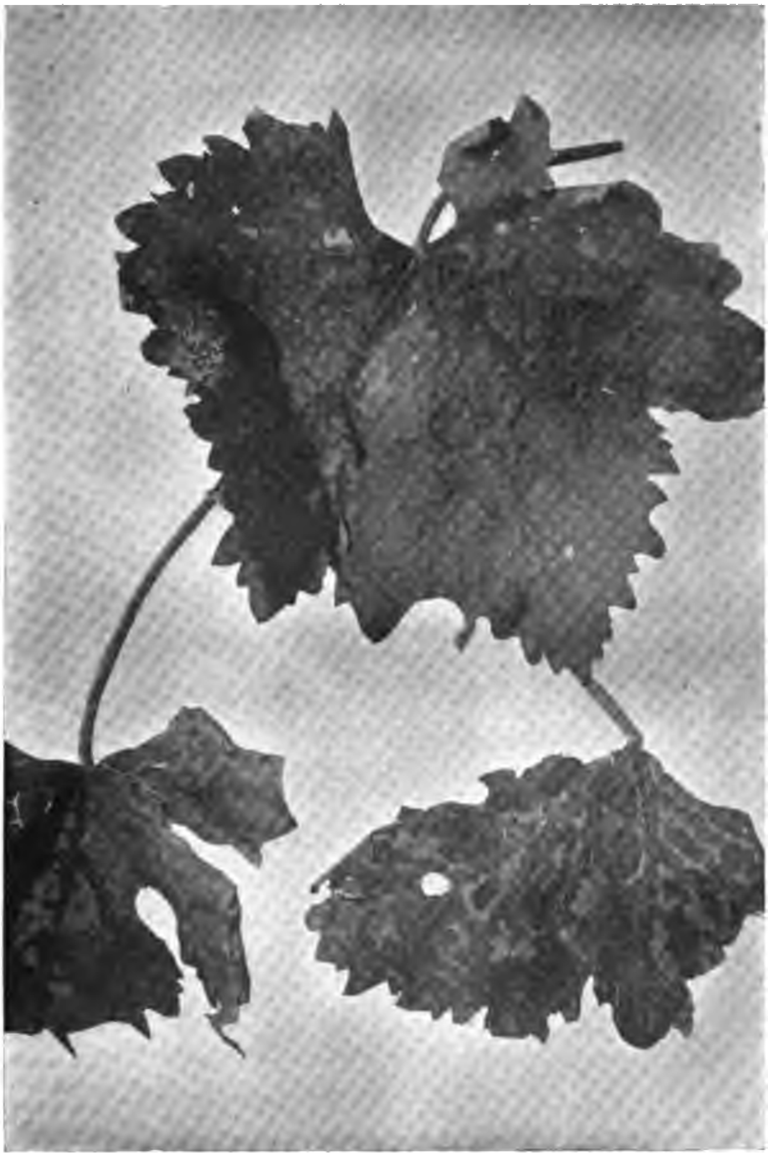

PLATE III. LEAVES OF VINES INJURED BY SUNSTROKE.

much more on the Muscats than on the stronger-growing Sultanas. The trouble is apparently simply a drying up of the vine, caused by a lack of adjustment between the water evaporated from the leaves and that taken up by the roots. The primary cause is probably the abrupt changes in the bottom water-level.

The trouble is that known in France as "folletage," and is physiological and not properly pathological in its character. It is thus described by G. Foëx: "Folletage occurs ordinarily in July or August, on vines which, up to the time of attack, have been healthy and vigorous. There are no preliminary symptoms. Isolated vines or patches of vines show a wilting of the leaves, which gradually fade and die; the shoots commence to dry up from the tips, and soon the whole vine dies. Sometimes the vine is less severely attacked and does not die. It receives, however, a severe check, from which it rarely recovers completely. It is particularly common in rich, deep soils which are damp and where the water-level is high, especially in wet years, and when the soil is poorly drained."

It may be caused by anything which disturbs the equilibrium between the water evaporated from the leaves and that taken up by the roots. A sudden period of dry, hot weather may cause more evaporation from the leaves than can be counteracted by the absorbing action of the root hairs. A sudden rise or fall of the water-level may cause the destruction of the root hairs, and thus render the vine incapable of replacing the evaporated water. In the case of the Fresno vines it is doubtless a combination of these two conditions that is responsible for the damage. There is practically no cure if the vine is badly affected. It is, therefore, very important to avoid the evil by careful management of irrigation and a close attention to the water-level.

BOTRYTIS CINEREA.

The *Botrytis cinerea* is the famous "noble mold" of the Rhine and Sauterne wine districts. It is known as *Edelfäule* by the Germans, and as *Pourriture noble* by the French. As these names indicate, it is held in esteem and is considered beneficial to the wine. It appears about vintage time as a grayish-yellow, powdery mold upon the surface of the grape. Its main effect upon the grape is to soften and partially disintegrate the skin. This, in dry weather, allows a certain degree of evaporation and concentration of the juice of the grape. This is a very valuable result for countries where the grape ripens with difficulty, or where an especially heavy must is desired. In wet weather, however, this thinning of the skin is dangerous, as it allows the absorption of water and the growth of harmful molds which are liable to displace the *Botrytis*. According to Müller-Thurgau, after the *Botrytis* has penetrated the skin of the grape it lives more at the expense of the acids than of the sugar of the must. Thus, while the sugar is increased by the evaporation of water, the acid is decreased by the direct action of the mold. The mold also renders a part of the soluble albuminoids of the must insoluble, which results in a slower fermentation. The *Botrytis* is reputed to give a slight and agreeable bitterness to the wine of the grapes which it attacks. It gives none of the disagreeable "moldy" taste which is so characteristic of the commonest mold, *Penicillium glaucum*.

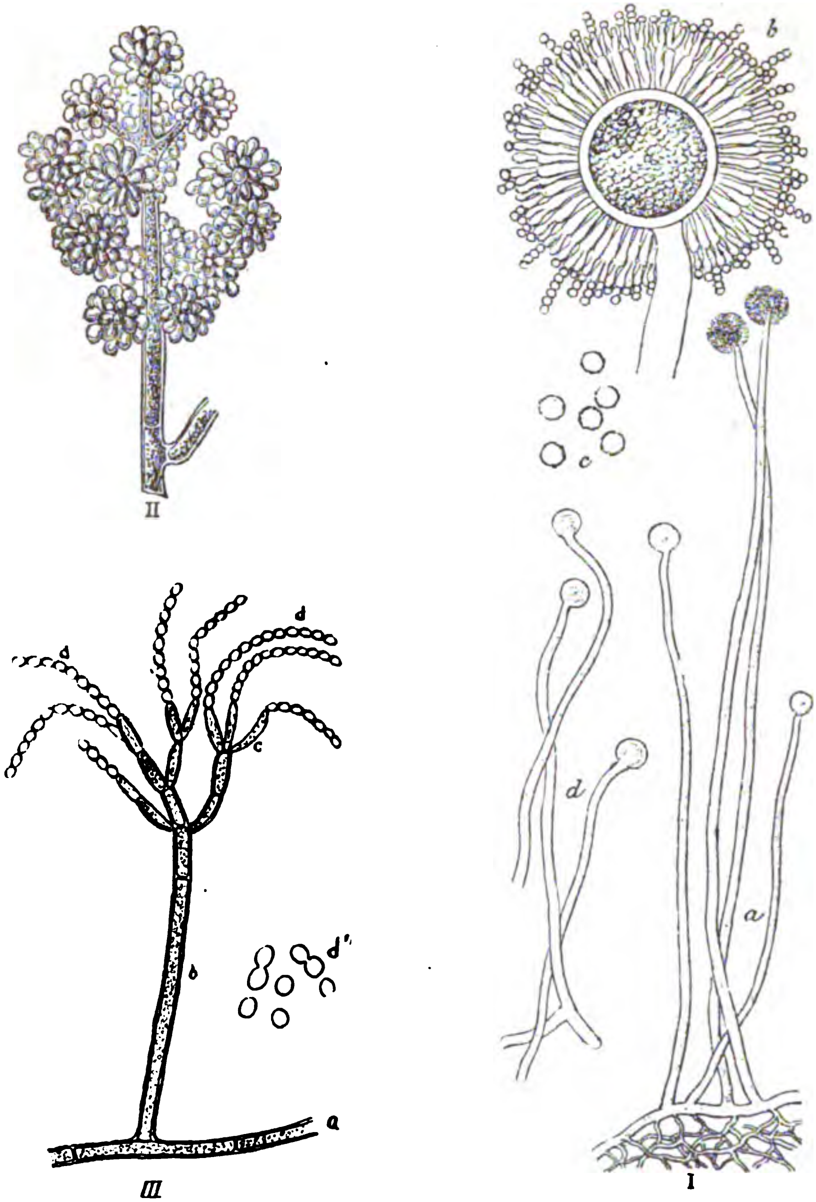

Plate IV. Grape Molds.

I. *Aspergillus niger.* (After Duclaux.)
  a. Fruiting hyphæ.
  b. Sporocarp showing formation of spores.
  c. Spores enlarged.
II. *Botrytis cinerea.* (After Ravaz.)
III. *Penicillium glaucum.* (From skin of moldy grape.)
  a. Mycelium or vegetative part.
  b. Fruiting hypha.
  d. Chains of spores. *d'.* Spores enlarged.

The presence of *Botrytis cinerea* on California grapes was first noted by Mr. A. P. Hayne during the vintage of 1893. He found it very common at several vineyards in the neighborhood of St. Helena, Napa County, and later at Mountain View, Santa Clara County. It has also been noticed at Mission San José, Alameda County, and at Asti, Sonoma County. It probably occurs all over California whenever the conditions are favorable. As some careful wine-makers were rejecting the grapes attacked by this mold or relegating them to the distillery, several experiments were made to determine the kind and degree of action which the mold had on wine. The conclusion was that a small quantity of the mold had no appreciable effect, but that if the grapes were badly attacked the resulting wine was apt to have a Sherry taste, doubtless on account of the preliminary oxidation of the must through the partially disintegrated skin of the grape. As, on the contrary, other molds are well known to have a very injurious effect on the flavor of wine, it is important to distinguish between them and the *Botrytis;* therefore, a short description of *Botrytis cinerea*, of *Penicillium glaucum*, and of *Aspergillus niger*, the molds which are found most abundantly on grapes in California, will be useful.

The *Botrytis cinerea* is but a form of the *Sclerotinia Fuckeliana*, a fungus which is common on all parts of the vine. As it is the only form which at all affects wine-making, it is the only one described here. It appears on the surface of the ripe or nearly ripe grapes as a thick olive-gray layer. This layer consists of the mycelium or fungal threads covered with masses of spores. The microscopic view of the fungus may be seen in Fig. II. It will be noticed that the spores are in roundish bunches, and not joined together in chains as are those of *Penicillium.*

Penicillium glaucum is the common blue mold, found on almost all kinds of fruit which have been kept for a length of time in a damp place. In general, it can be distinguished from *Botrytis* by its bluish-green color and moldy odor. As may be seen by the microscopic view in Fig. III, the spores are in chains, which all have their origin at the ends of short branches springing from the end of a fruiting hypha or filament. This mold is seldom found in quantity on grapes before they are picked, except in rainy weather. It usually develops in the boxes and can be avoided by crushing the grapes as soon as possible after picking.

Aspergillus niger is the black mold which annually destroys tons of grapes in the warmer and irrigated portions of California. On account of its black color it cannot be mistaken for either of the above molds. Fig. I shows its microscopical characteristics. It attacks grapes which have closely packed bunches and tender skin. It is especially harmful to Zinfandel grown on irrigated land, and sometimes destroys the whole crop before it is ripe enough to gather. The best method of prevention is to adopt a method of pruning and training that will not permit the bunches of grapes to press against each other and which will allow a free circulation of air between them.

LIST OF VITICULTURAL PUBLICATIONS OF THE COLLEGE OF AGRICULTURE, AND OF ALL PUBLICATIONS OF THE LATE VITICULTURAL COMMISSION.

The publications of the University Experiment Station will be sent free to any address on application to the Director.

The large number of reports of the late Viticultural Commission, which were transferred to the Experiment Station by Act of the Legislature, can also be had on application, when accompanied by the necessary postage, as shown in the list given below. These State reports are not included in the class of Station publications allowed by Act of Congress to pass free through the mails. While the Viticultural Commission, with its annual appropriation of $15,000, could well afford to spare enough for postage on its reports, the Station cannot thus draw on the small sum of $2,500 given to the University to carry on the viticultural work.

REPORTS OF THE COLLEGE OF AGRICULTURE.

Date of Issue.	Title.	Postage.
1886....	**Report of Viticultural Work during the Seasons of 1883-84 and 1884-85.** *Contents:* Legislation concerning viticultural work. Statement of general objects and plan of work. Report of Committee of State Viticultural Convention of 1884. Wine Fermentation: The several fermentations; ferments. Circumstances that determine the several fermentations. Influence of temperature. The lacto-butyric, mucous, and mannite fermentations. The acetic fermentation. Conservation of wines. Points in the fermentation of red wines. Extract of report on "Studies on Wine Fermentation." Record of work in the viticultural laboratory for the season 1883-84. Tables showing proportions of pomace, must, etc., and composition of wines. Descriptive list of wine samples received 1883-84. Composition of Zinfandel wines. Record of work in the viticultural laboratory for the season 1884-85. Descriptive list of grapes received and wines made, with analyses of musts and wines. Descriptive list of wines sent for examination during season 1884-85. The vintage of 1885. University experimental plot at Cupertino. Record of work relating to the phylloxera. Mercury vapor as a remedy against the phylloxera. The phylloxera at Berkeley.	Free.
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1888	**Reports of Experiments on Methods of Fermentation and Related Subjects** *Contents:* Composition of wines made by different modes of fermentation. Fermentation under different conditions; effect of temperature. Revival of fermentation. Zinfandel fermentations. Behavior of highly saccharine musts. Extraction of color during fermentation. Effect of climate on composition of musts. Aëration. Pasteurization of wines. Red wine from condensed must by the Springmuehl process.	Free.
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PUBLICATIONS OF THE STATE VITICULTURAL COMMISSION.

Date of Issue.	Title.	Postage.	
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1881	**Report of the Board of State Viticultural Commissioners for 1881**		6 cents.
1881	**Report of the Board of State Viticultural Commissioners for 1881.** Second edition; revised *Contents:* Acts of the Legislature. Reports of President, Officers, and Members of the Board. Diseases of vines. Raisin-making in Spain. Wild vines of California and Arizona. Seedlings. Vine of the Soudan. California wines. Permanent maintenance of our vineyards. Appendix A–H, J. Phylloxera and its treatment. Appendix I. Grafting American vines. Sessions of the Board.		5 cents.

Publications of the State Viticultural Commission—Continued.

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1888....	**Report of Board of Viticultural Commissioners for 1887** *Contents:* Report of President of the Board. Index to some reports of Board. Statistics of exports of wines and brandies. Reports of Commissioners. Report of Secretary of Board. Catalogue of books in Viticultural Library. Report of Chief Viticultural Officer. *Oidium Tuckeri*, and the use of sulphur. The pure-wine bill. Bleaching Seedless Sultana raisins. How to avoid and correct imperfect fermentation. Vineyards in the south of France. Treatment of wine by electricity. Herbaceous grafting. Report of the State Analyst. Arsenic remedy for grasshoppers.	6 cents.	4 cents.
1888....	**Report of the Sixth Annual Convention** *Contents:* Raisin-making; Table and shipping grapes. Resistant vines and grafting. Vine pests and remedies. Chaintre system of pruning in California. Wine cellars for interior valleys. Wine-making machinery and cellar construction. Wine and brandy-making as a profession. Electro-magnetism for aging wine. Sherry flavors in wine. Fermentations at Viticultural Laboratory. Distillation of grape brandy. Temperance reform. Fermentation and California wines. Sophistication of wines. Our markets for wine, and wine-storage. How to drink wine: wine as a temperance agent.	7 cents.	5 cents.
1889....	**Wines.** By R. Boireau; translated by E. A. Schneider *Contents:* A short treatise on vinification. Care and treatment of wines in cellar and store.	6 cents.	4 cents.
1890....	**Report of the Board of State Viticultural Commissioners for 1889-90** *Contents:* Report of President and officers. Report of E. Dowlen on Anaheim disease. Raisins. Resistant vines in Sonoma. Tariff and sweet-wine bill.	9 cents.	7 cents.

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Date of Issue.	Title.	Postage.	
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1891....	**How to raise the price of grapes, and an analysis of the sweet-wine law**	....	1 cent.
1891....	**Report of George West for 1891**	....	1 cent.
1891....	**Directory of the grape-growers, wine-makers, and distillers**	....	6 cents.
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	Contents: Reports of officers of the Board. Appendix B. Transactions of the Eighth Viticultural Convention. Appendix C. Utilization of wine residues, by A. Dal Piaz. Appendix D. Import duties of various countries. Appendix E. Wine: Classification, tasting, qualities, and defects. By G. Grazzi-Soncini. Resistant vines.		
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1894....	**Treatise on Wine Production**	....	4 cents.
	Contents: Part 1. Types of European vintages. Conditions affecting the quality of California wines. Part 2. California wines at the World's Columbian Exposition. Part 3. Tariff and internal revenue taxes. Part 4. Chemical analyses of California wines.		

Of some of the early reports of the Viticultural Commission the supply is so nearly exhausted that they cannot be offered for general distribution, and hence are not included in the enumeration.

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The page on which will be found the special description of each variety of grape, together with the analyses of its musts and wines, and the records of treatment and tasting during vinification, is given in full-face type.

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UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

BERKELEY, CAL.

E. W. HILGARD, Director.

BULLETIN No. 117.

THE CONTROL OF THE TEMPERATURE IN WINE FERMENTATION.

JULY, 1897.

The Control of the Temperature in Wine Fermentation.

By A. P. Hayne.

The Control of the Temperature. The fermentation of wine must, or the juice of the grape, results in the main in the splitting up of the sugar it contains into almost equal parts of alcohol and carbonic acid gas. While there are other products of fermentation, it is not essential for our immediate purpose to dwell on them in this connection. The transformation of sugar into carbonic acid gas and alcohol is a chemical action caused by minute plants or ferments called yeast. It is well known that *all chemical changes of this sort produce heat;* and thus it will be seen that the temperature of a fermenting mass of a sugar solution (grape juice), while it depends to a certain extent upon the outside temperature, is chiefly dependent upon the *amount of heat generated within the tank itself.* The amount of heat, then, that is produced in a fermenting-tank depends upon, first, the percent of sugar in the must and the quantity of must; second, the facilities offered by the tank and air for carrying off the heat generated by fermentation, or conductivity of the tank-walls, the amount of surface exposed to the air, the circulation of the must within the tank, etc.; third, the activity of the yeast cells, *i. e.* the rapidity of fermentation.

Percentage of Sugar. The amount of sugar in the must varies from year to year in the same place with the same varieties. In hot countries there is, other things being equal, more sugar in the must than in cold countries. Some varieties of grapes give more sugar than others; and as high alcoholic strength is, unfortunately, paid for as such by the merchant, grape growers are apt to select those varieties that produce the most sugar, and hence alcohol in the wine, regardless of true quality. While this may be proper enough in cold climates, it works great injury to the general reputation of the wines of warmer countries, for alcohol is not the only desideratum in wine. In hot climates there is almost always, with the excess of sugar, a correspondingly smaller amount of acid. It is, however, important to note that very high sugar contents of must and low acid generally go together, and that they both are, as a rule, undesirable.

Excess of Heat. The amount of heat generated within the fermenting-tank is very great, being sufficient, theoretically, to raise above boiling point the whole of a must rich in sugar. Practically, however, the heat is generated gradually; and much of it is carried off by the gas generated, as well as through the walls of the vat, and from the surface of the fermenting liquid; otherwise fermentation beyond a certain point would be impossible. This fact has taught wine-makers in warm countries the necessity of a free circulation of air in the fermenting-room, unless that air is hotter than the temperature of the fermenting mass. Hence the benefit of the practice of fermenting in small packages with thin walls: first, because of less actual amount or quantity of heat (calories) generated; and, second, because of the facility with which this heat can be carried off and thus the equilibrium between the temperature of the fermenting mass and the outside air be maintained. This has led many wine-makers to have their tanks made of small diameter, of great height, and of very thin material of high conductivity, such as thin enameled iron. While this certainly enables the operator to completely control the temperature, it has proved far too expensive for general use. But unquestionably the growing custom of using very large tanks is essentially bad practice.

Activity of the Yeast. The third factor in the problem is the activity of the yeast-cell. There are many circumstances that modify this activity. First it must be remembered that the yeasts are plants, and that, in a general way, their growth (activity) is modified by the same conditions that affect the higher plants growing in the fields. Extremes either of heat or cold are unfavorable to their maximum development. Thus in cold climates the wine-maker keeps a fire constantly burning in the fermenting-room, while in hot countries all his energies are bent on reducing the temperature to that most favorable for proper fermentation.

It is also noted that the higher plants have different "*optimum*" temperatures; for there are tropical plants, plants of temperate regions, and plants that grow in the arctic regions. It is the same, within certain limits, with the yeast plants. This variation is, as yet, but little known, for it is within but a few years that serious attention has been given to this branch of science so magnificently set forth by Pasteur. Suffice it to say that something has been done, and that the beer brewers have put these principles in practice with eminent success. Now the yeast plant of the brewers splits up sugar into alcohol and carbonic acid gas, just as the wine yeasts do, and is influenced by exactly the same conditions.

In the case of the seeds of the higher plants of all kinds, activity does not begin until the proper temperature has been reached. Should the temperature in spring rise slowly, the growth of all plant life is correspondingly slow; but so surely as a sudden great rise in temperature takes place, plant life will be intensified by it until, when excessive temperatures are attained, it is either paralyzed temporarily or the plant may die.

Similarly, if the grapes arrive at the fermenting tank much heated, then we may look for a sudden violent development of yeast-plants or fermentation. This is unfavorable for several reasons: first, because the *heat is generated so rapidly* that a due amount can not be carried off in time by conduction, and high temperature is reached very quickly, whereby the yeast may be paralyzed or killed. But more than this; within certain limits each degree of sugar in the must means a corresponding amount of heat generated in the tank. Now if fermentation starts in at a low temperature, say 56 degrees F., the generation of heat will be slow at first, and the rate of fermentation will be correspondingly slow, and *apparently* less heat will be generated than if started at a higher temperature; because much is lost by conduction, although the *amount* is actually the same. The starting point was so low that the heat that was not carried off by conduction is not sufficient, when added to the initial temperature, to carry it to the killing point. Let the initial point be 75 degrees F., as is frequently the case, then the extra heat added by the greater rapidity of fermentation will carry the temperature, without doubt, to the death limit. Hence the many efforts made to get the grapes into the tank in a cool state. Wherever this can be done, the fermentation usually goes through well; but practically this is possible only on a small scale. Hence in a warm climate like that of California the initial temperature of the must is always over 60 degrees F., and in some cases over 76 degrees F. The danger arising from over-heating is, therefore, naturally to be expected. Actually, at all the wineries of this State, over-heating does occur almost continually, and great financial losses result therefrom.

Nourishment. But aside from the general climatic conditions, all plants are profoundly modified in their growth by the nourishment they receive from the soil in which they grow. Aside from the sugar required to nourish the yeast plant, one of the most important factors in the problem of its growth is the acid. There are other factors, but these are not essential in this connection. Now just as there are plants that will grow in alkali soil, and others that will not: so there are yeast plants that will thrive in a non-acid medium, and others that will not.

Diseases of Wine. This brings us to the plants that cause the *diseases* of wine; for it should be understood once for all, that a "spoilt" wine is spoiled not spontaneously, but by the growing in it of some minute plant which uses the substances of the wine to nourish itself, and to produce both its natural products, most of which are foreign to normal wine, and unpalatable besides. Thus the bacteria of putrifaction destroy otherwise edible meat and render it unfit for human consumption. In the same manner all diseased or "spoilt" wines have been rendered so by some plant of a lower order than the yeast-plant that gave it its quality.

Importance of Proper Temperature. Returning to the question of temperature, it has been established beyond the possibility of rational dispute that, in the majority of cases, those temperatures most favorable to the wine-yeast plant are unfavorable for the development and growth of disease-plants or bacteria, and *vice versa.*

In a general way we may say that the wine-yeast is a plant of the temperate zone, while the disease bacilli are plants of the tropics; the one requiring moderate heat for its normal growth and the other requiring a much higher temperature in order to grow and act at all. *This explains the practice of keeping wine in cool cellars.* This is a very important point. High temperatures are very *unfavorable* for normal wine-yeast, and very *favorable* to the bacteria which cause wines to spoil. After the limit of temperature favorable to the yeast-plant has been passed, the quality of the wine deteriorates with great rapidity; not necessarily because the wine-yeast is actually killed, nor that its action has ceased altogether; but that its activity has been checked, and that the harmful bacteria have begun their work; producing, not alcohol, carbonic acid gas, glycerine, etc., but their own characteristic products such as mannite, acetic, lactic, and butyric acids, etc., etc.

Paralysis and Death of Yeast-plants. The degree of paralysis of the yeast-plant depends upon the temperature and composition of the must. The absolute point of temperature at which paralysis or death will overtake the yeast-plant cannot be fixed absolutely, as it depends upon the variety of ferment or yeast-plant, as well as upon the conditions in which it works best. For normal musts with a normal yeast, the death point is generally from 98 to 100 degrees (F). Some varieties of yeast (and these are few) will stand more heat, most of them suffering greatly before this point is reached; the must also should be of a composition naturally favorable to them. Before this point is reached the bacteria begin to develop, while the wine-yeast stops growth and the wine, if not spoiled, is rendered of less value than it would have been, had the temperature remained lower.

Effect on Bouquet and Aroma. It should be noted in this connection that, with certain reservations, the general rule is that the lower the temperature of fermentation the better the aroma and bouquet of the wine. In other words, the proper regulation of the temperature of the must during the first or tumultuous fermentation means the production of a wine richer in alcohol, of better keeping qualities, and better quality throughout.

Use of Antiseptics and Antiferments. With this review of the general principles governing fermentation, we come to the practical lessons deducible therefrom. We have had occasion to note the heavy annual loss to wine-makers from "stuck tanks," resulting either in the total destruction of the wine, or the partial loss of its market value. We have also had occasion to listen to the criticisms of the purchasers of California wine, both abroad and in this country; and in by far the greater number of cases the fault found was not so much with the quality, (for well-made California wine compares favorably, grade for grade, with any in the world) but in the *unsoundness*, *i. e.* the tendency to spoil on the hands of the purchaser before reaching the consumer. This has led to the use of antiseptics, "anti-ferments," that is poisons which kill outright or paralyze, not only the wine-yeast but all bacteria that might intervene, and in some cases the consumer as well. The making of wine at high temperatures is simply inviting the use of antiseptics; for, as a matter of fact, *unsound wine can only be marketed by the use of some powerful agent, to keep the bacteria in check.* Few wine-makers realize the great harm done to the reputation of Californian wines by a few unscrupulous or ignorant dealers who systematically buy up unsound wines, "doctor" them, and ship them abroad. The sooner the use of antiseptics of any kind (except pure wine alcohol) is stopped, the better it will be for all concerned in viticulture. It is to be regretted that there is no law enforced that punishes those who use dangerous drugs in wine.

Stuck Tanks. A "stuck tank" is a very common occurrence at most all wineries in California, as well as in all countries having similar climates. It means that the yeast germs that convert the juice of the grape into wine have suddenly ceased their normal action, and fermentation proper has ceased, while bacterian activity has started up; resulting either in the total or partial loss of the wine. One wine-maker of this State told us that his loss from stuck tanks amounted in a single season to $10,000; and there are but few who do not suffer to a certain extent from this trouble.

As has been shown, the commonest cause of stuck tanks is too high temperature. The trouble is not by any means confined to California; but is the curse of all wine-making countries in the warmer parts of the world, viz. all Southern Europe, North and South Africa, Australia, etc. The wine-maker of these countries has been found to be less self-complacent than his California brother, and has made serious efforts to control the temperature of fermentation.

Methods of reducing Temperature. By some wine-makers the amount of sugar was reduced by the *addition of water*. This, in many cases proved of great service, but in others it was not so; for the water also reduces the acid and the body of the wine, and unless there be sufficient acid, normal fermentation does not take place, save under exceptional circumstances. Others tried to reduce the temperature of the wine by the *addition of ice* to the fermenting tank. This had not only the same effect as the addition of water but proved utterly impracticable in the case of red wine and is not economical. Some tried the use of *metal spiral coils* plunged in the fermenting tank through which cold water was passed. This proved successful in the case of wine fermenting without skins or stems (white wine); but was impracticable in all cases where the skins and stems were left in the tank, owing to the impossibility of sufficiently mixing the hot and cold parts of the fermenting mass. Others tried *metal tanks*, but this was found to be too expensive.

Again, some tried pumping the wine from the bottom of the tank over into the top and allowing it to spread out in a spray. This accomplished two results: it *cooled* the wine slightly (but very slightly) and especially did it *revive* the partially paralyzed yeast cells by giving them a fresh supply of free oxygen. The fatal defect of this practice was found to be that too great oxidation and evaporation of the alcohol, which took place at high temperatures, the wine becoming too highly charged with acetic acid (vinegar-sour). Nevertheless, this pumping over of the wine of stuck tanks, or tanks that threaten to stick, is now widely practiced all the world over, and in the case of a sudden stopping of fermentation it is necessarily done to supplement the addition of fresh must in active fermentation used to finish the conversion of the sugar into alcohol and carbonic acid gas.

Experiments at the University. Convinced of the necessity of controlling the temperature of the fermentation of wines in this State, (just as the brewers do that of their fermenting wort to a fraction of a degree, always getting a product the value of which is known beforehand), the Viticultural Staff of the College of Agriculture set about to devise some practical method for attaining this end. It was only after having completed the experiments with the apparatus herewith described, that we received detailed data of the European experiments with the refrigeration of wine. We give below a complete description, first, of the French apparatus; second, of the one first devised at the Experiment Station; and, third, of the one modified as found advisable after thorough trial.

Apparatus used in other Countries. Figure 1 represents one of the forms of the apparatus now used throughout Northern Africa and Southern France. As will be seen, it consists essentially of two columns, each made up of nineteen thin, well-tinned, horizontal copper tubes. These tubes are 13¼ feet long by 1½ inches in diameter. The total length of the tubes through which the wine passes is thus nearly 500 feet. These tubes are fitted into solid bronze castings closed by means of a bronze plate over a rubber washer, with thumb screws. The two columns are connected by a tube (3 fig. 1) running diagonally from the top of one column to the bottom of the other, so that the hot wine entering at the lower end (7 fig. 1) of the first column, and after passing upwards and completing the circuit in this column, passes to the bottom of the second column, from

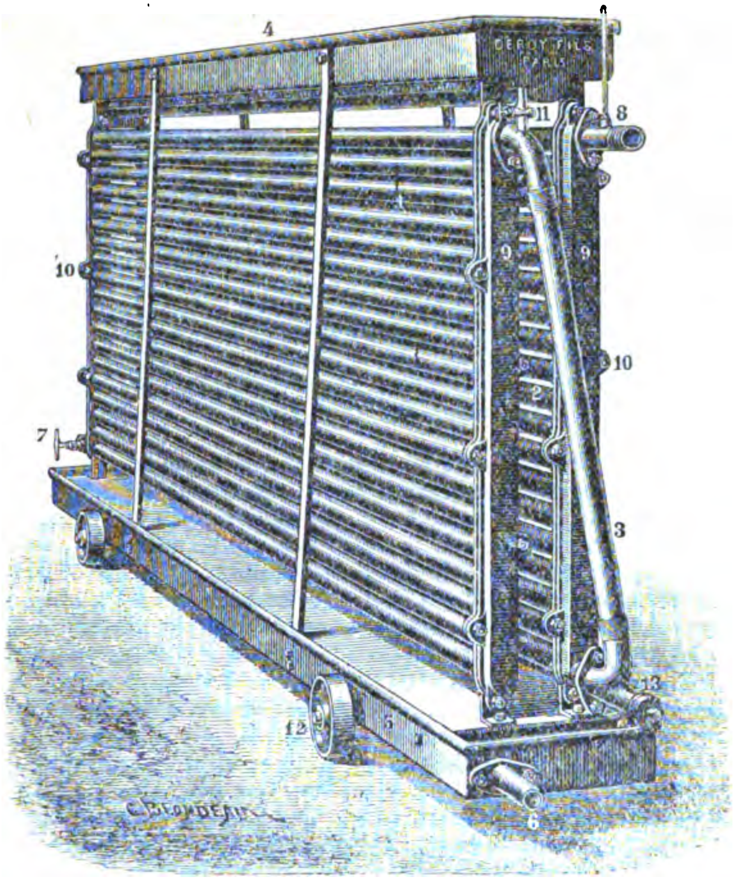


Fig. 1.

which again it escapes at the top. Above the two columns of tubes is a large metal water-box, having two rows of holes in the bottom corresponding to the two columns, from which cold water is allowed to drip as the warm wine is pumped through the tubes. Under the apparatus is a metal box which catches the drip of warmed water. Each column of tubes has a stop-cock (13) which allows rapid emptying of the wine when pumping is stopped. The apparatus is, as before said, now actually in use in other countries and we are indebted to the excellent report of Messrs. Müntz and Rousseaux in *La Revue de Viticulture* for the results of their exhaustive experiments conducted in France during the past season, 1896, as well as during the season of 1895.

The first defects that strike one in this apparatus is the unwieldiness and expense, as well as the large amount of labor required to force a one-and-a-half inch stream of wine through such a length of tubing at a working rate; then the amount of water used in cooling the wine must be very large, unless the temperature of this water be considerably below that of the wine. As in the case of the use of ice, it will do well when all conditions are most favorable.

In a recent article, giving a resumé of the two seasons' experiments, Messrs. Müntz and Rousseaux tell us that to work the apparatus, a gang of four men, working in relays, is required to pump forty hectoliters or 1060 gallons per hour. With a motor engine, double this amount could be pumped through, but the *quantity of water* needed in this case for the proper cooling of the wine is enormous, amounting to from one to one-and-one-half times the amount of wine passed through ; or far more cold water than is generally to be had at the average California winery.

The reduction of temperature was in some cases very great, but depended altogether upon the rate of pumping, the amount of water dripping over the tubes, and the initial temperature of this water. There was an average reduction, however, of from 10 to 12 degrees F., but in some cases a maximum of as much as 20 degrees when slow pumping was practiced. The cost of cooling the wine was, on an average, one-thirteenth of one cent per gallon.

From the careful tests made by these eminent scientists, the remarkable benefits of cooling the fermenting mass was strikingly shown. In all cases a certain lot of the same must was fermented in the usual way as a check to the experiment, and in every case the cooled wine was sounder and of far better quality. Microscopic examination showed that the uncooled wine was teeming with harmful bacteria, while the amount of unfermented sugar remaining was very considerably more than in the case where the wine had been cooled. The University experiments showed this as strikingly as did those of Müntz and Rousseaux.

We give below a table taken from *La Revue de Viticulture* in which some of these results are set forth. Unfortunately the recent disastrous fire at the Agricultural Building at the University destroyed all the notes taken at each tank cooled, so that we can but give the general results. These results were, however, *looked over but a few days before the fire* and being compared with those made in France by Müntz with his apparatus were found to be essentially in accord, as appears from the data given below. We give below the exact figures obtained by these observers. This shows the matter to be not of something "*theoretical*" and untried, but something that has been *tried by several, and proved to be a practical success.*

The experiments were made in the Roussillon district of France, near the Eastern Pyrenees, during the season of 1896, with Carignane grapes.

	Maximum temperature of the must during fermentation	Alcohol per cent.	Unfermented Sugar.
Cooled Wine	96 (F.)	11.00	
" "	96.8	11.45	.59
" "	99.5	11.50	.65
Uncooled Wine	102.2	10.20	2.60
" "	104.0	10.10	3.30

It will be recollected that experiments made by Prof. Hilgard at the University, in 1887, gave almost precisely similar results as to alcohol percentage when hot and cool fermentations were compared. (See Report of the College of Agriculture on Methods of Fermentation of 1886-87, p. 28.)

The effects of high temperature on the composition of the wine may be further illustrated by some other analytical results from the French experimenters, Müntz and Rousseaux, who found in 1895 that a wine which had attained a maximum temperature of 98.5 degrees F., during fermentation showed on analysis .066 percent of ammonia, while another wine made from the same lot of grapes, which attained a maximum of 104 degrees, showed .60 percent. Similar results were obtained in 1896, when maxima temperatures of 94 degrees and 104 degrees gave .03 percent and .22 percent of ammonia respectively. It is clear, therefore, that serious chemical differences and defects are produced in the wine by high temperature fermentations apart from the swarms of disease bacteria which are always present in such wine. Of the wines made by Müntz and Rousseaux in their 1896 experiments, those that were not cooled threaten to spoil already; while those that were cooled are in perfect condition.

EXPERIMENTS MADE BY THE UNIVERSITY AT NATOMA, SACRAMENTO COUNTY, AND AT EVERGREEN, SANTA CLARA COUNTY.

Apparatus used. The results of Müntz and Rousseaux were amply confirmed by the investigations undertaken by the Viticultural Staff during the season of 1896 at the Natoma Vineyard in Sacramento County, and at Mr. Wehner's at Evergreen, near San Jose. The apparatus used by us differed greatly from that used by Müntz and Rousseaux, and the many others abroad who practiced refrigeration during fermentation at the same time.

Not being able to avail ourselves of the detail of the numerous experiments undertaken along the same lines abroad during the past few years, we had to construct our apparatus independently upon what we considered the most promising lines; fortunately, as it turned out, committing few mistakes and obtaining results that show our system to be far superior to any thus far proposed for California conditions. However, experience has shown us the desirability of certain changes and modifications as hereinafter shown, especially as mechanical power for pumping and crushing is available at nearly all wineries of this State.

The apparatus shown in figure 2 is the one designed and used by us in the experiments. It will be observed that insofar as the pumping of the heated wine through tinned copper tubes goes, the principles are identical with those of the French apparatus. The method of pumping is the same as is in practice at wineries for drawing off the newly fermented wine from the fermenting tank. The wine is drawn off from the bottom of the tank and strained through a sieve into a tub, from which it is pumped through the apparatus into the top of the tank again. In other respects there are important differences; thus, instead of two columns consisting of 498 lineal feet of tubing, our apparatus consisted of a single column of only 42 feet of tubing. The tinned copper tubing instead of being *perfectly round is very much flattened*, thereby giving greater cooling surface to the same volume of wine, a material improvement on the French

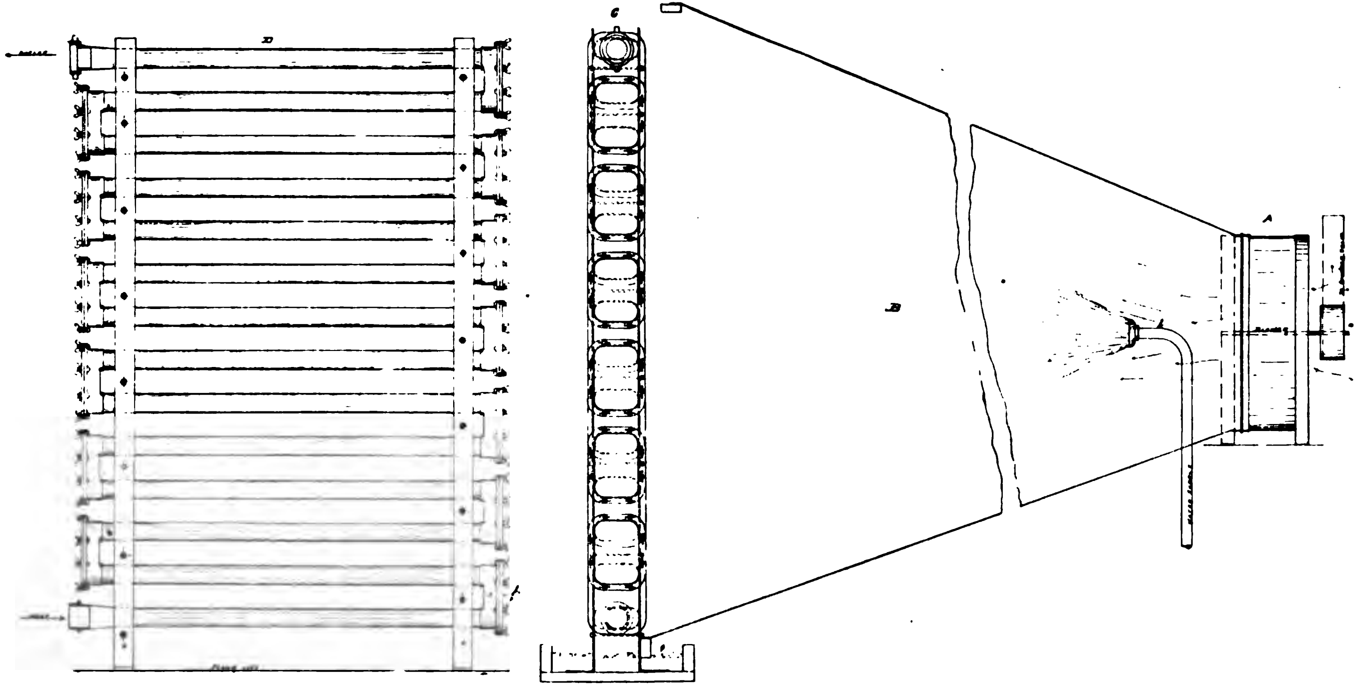


Fig. 2.

system of round tubes. It consists of 14 pieces 3 feet long and 4 inches broad, by 1½ inches deep. These tubes are fitted into bronze castings which are closed by plates fitting over rubber washers, and fastened by thumb-screws, thus allowing the tubes to be readily cleaned in cases of obstructions that might occur in the pumping through of the muddy, partly fermented must.

METHODS OF COOLING.

Water-box. In our first experiments the whole apparatus, that is to say the column of tubes, was fitted into a box, tin-lined and filled with water. A constant supply of fresh water entered the box at the bottom, escaping from the top, while the wine entered the top of the apparatus and escaped at the bottom, in order that the *coldest wine* should come in contact with the *coldest water*, and *vice versa*. It is well known that this arrangement will give the greatest amount of cooling effect.

It was found that by the use of a very large quantity of water the wine could be sufficiently cooled, but the excessive amount of water thus required caused us to abandon this system. In special cases, where an unlimited water supply is to be had without too great expense, this system should be adopted, for though the cost of water-box and installation will about offset the cost of the blower and canvas sleeve, hereinafter described, it has the advantage of doing away with the necessity of the command of power. In case this system is adopted, it is well to use a greater length of tubing than would be required where the spray and the air current are used. Roughly speaking, the amount of water used in this case should be from 1½ to 2½ times the volume of wine pumped through the apparatus.

Drip, Spray and Blast. Instead of depending upon the simple dripping of the water over the tubes to effect the reduction of temperature of the warm wine, a great saving of tubing, as well as labor in pumping, was found to be effected by the use of a fine spray of water carried by a strong blast of air, thus combining the effects of cold water and evaporation. The quick evaporation brought about by the dry air prevailing at our vintage season, when mingled with a fine spray, produces a cooling effect far in excess of what could be obtained from the ordinary water at the wineries alone. This is important, for at many of the wineries the water available is very warm and the difference between the temperature of the water and the wine to be cooled is so slight that it would be impossible to effect a proper amount of cooling, unless enormous volumes of water were used.

The proper proportions between the air blast and the amount of water sprayed is of the utmost importance. It is readily understood that a weak blast with a large amount of coarsely-sprayed water would leave the temperature of the water almost unchanged when it reaches the cooler, and would, therefore, amount to little more than the dripping practiced in the French apparatus; while if the blast be in excess and the water deficient, the amount of water carried may not be sufficient to utilize the evaporative power of the blast, nor to thoroughly wet the tubes. Again, to insure the maximum cooling from evaporation, the spray should be so fine that within the short distance from the nozzle to the tubes the air may become fully saturated, and both cooled to the fullest extent. Of course, the heavier the blast, the more water spray can be carried and cooled by it.

To produce the requisite fineness of spray, an adequate water pressure is necessary.

Another factor of the utmost importance is the dryness, or what is technically called the "relative humidity" of the air used. During the vintage season this is frequently as low as 33% *outside of the winery;* and the intense evaporating effect producible under such conditions should be utilized by connecting the intake with the outer air. This, of course, can be done either by a canvas tube stretched by hoops, or by a board flume.

When, as may happen near the coast, the moist condition of the air is unfavorable to strong evaporation, the water temperature, on the contrary, is frequently itself so low that an energetic spray without a blast may suffice to do the necessary amount of cooling.

It will be noted, therefore, that the best conditions for cooling will vary, not only in different localities, but on different days, and according to the prevailing wind; so that it is impossible to prescribe the exact strength of blast or quantity of spray that should be used. But a few experiments will determine the best practice in any given locality.

In our experiments the blast of air was generated by means of an 18-inch "double" (8-wing) blower, or "exhaust-fan" reversed. The water escaped from a battery of three Vermorel nozzles placed immediately in front of the blower.

A conical canvas sleeve attached to the outlet of the blower and five and one-half feet away to the circumference of the cooler-frame prevents the loss of blast and spray.

The "double" 18-inch blower requires under ordinary circumstances less than one-half horse-power to run it at a rate of 1000 revolutions per minute, and thus, with a free supply, will pass 3000 cubic feet per minute through it. The 24-inch "double" blower requires about the same horse-power to run it, but requires only 900 revolutions per minute to send through 5000 cubic feet in the same time. It should be remembered that the best efficiency of every blower is limited to a definite velocity of revolution. The figures above given refer to the most favorable velocities for the sizes mentioned. The one costs $40.00 (less discount) while the latter costs $50.00. In order that the apparatus may be available at small-scale wineries, where no steam is used, it may be well to state that a small gas engine, run with common "distillate" and giving two and one-half horse-power, can be had for $187 (less discount). The cost of running such a motor is one cent per horse-power per hour; a trifling expense, especially as the motor, once started, will run itself, so that one man can attend to the pumping of the wine and the running of the engine at the same time. Indeed, with a little fitting, such an engine could be made to do all the pumping in the cellar, and there are no laborers who will do one horse-power of work for a cent an hour.

While the French apparatus was movable, ours was of necessity fixed, but with one man at the pump at Mr. Wehner's place it was found that he could pump from the most distant tank at the rate of 1000 gallons per hour, in some cases as much as 1400 gallons. At this rate a reduction of temperature of from 10 to 13 degrees was obtained in the wine. The temperature was taken at the point where the wine left the tank and again where it re-entered the tank after having passed through the cooler.

Precautions. We found that the much-feared *deposit of cream of tartar* on the inside of the tubes was very slight indeed. It would seem that while warm wine on cooling will deposit cream of tartar on the lining of the vessel, wine constantly in motion (as when being pumped) will not deposit much. Even after long use it was found that the thin coating of cream of tartar on the inside of the tubes could be removed by pumping the apparatus full of water and leaving it over night after a few barrels had been pumped through. The apparatus should be flushed out at least once in twenty-four hours, for the deposit of cream of tartar, be it ever so slight, interferes greatly with the conduction of heat, and anything that has this effect must be carefully avoided. Even the surface of the tubes should be polished once a day with ashes or lye, for there forms on the surface, after a day's use, a "greasy" film, due to the lubricant necessarily used in the blower, which not only interferes with the conduction of heat, but causes the water to run in streaks over the surface instead of spreading over it, much cooling surface being thus lost.

The seeds and skins should be kept out as well as possible from the pump and consequently from the apparatus. By exercising due precaution in this regard, we did not have to clean the apparatus from this cause once during the entire trial.

Control of Temperature. We found, as did Müntz and Rousseaux, that when the wine passed 100 degrees, cooling was useless, for the ferments or yeasts were too badly injured to be revived. Thus a tank at Natoma (where the conditions were unfavorable on account of hot weather) was fermented with some Algerian yeast, and was allowed to go as high as 104 degrees. The tank "stuck" before fermentation was finished and it could not be revived by cooling.

Müntz and Rousseaux state, that if a tank is cooled before the temperature reaches the danger limit, there need be no fear that a subsequent rise to this limit will take place. We found at Mr. Wehner's that under the conditions existing, when the temperature in the tank reached 88 degrees, if we pumped about one-half or two-thirds of the contents of the tank through the cooler, nothing disastrous ever happened, although the fermentation kept right on and the rise in temperature continued, yet it seemed that a sufficient amount of heat (calories) had been removed from the fermenting mass to enable it to complete the fermentation without reaching the danger point. This favorable result, however, must largely depend upon special conditions, and should not be relied upon so as to relax vigilance.

Considering the fact that low temperature fermentation gives a wine of a different composition from that fermented at high temperature, and leaving for the moment the killing of the yeast out of the question, it is evident that it would pay to keep the temperature constantly below the danger limit on account of the superior quality of the resulting wine.

It might not pay in ordinary cases to go to this expense for quality alone, yet if extra fine wine is to be made, extra care must be bestowed upon it.

Aeration of the Wine. It was deemed advisable to aerate the wine whenever it was pumped over. In order to accomplish this, and at the same time to prevent the cooled wine from forming a channel in the cap and passing at once to the bottom and thus leaving the warmer wine at the top, we caused the wine to escape from the end of the hose in a fanlike jet, the direction of which was from time to time so changed as to reach all parts of the cap during the cooling. In this way the cap was very greatly cooled, which is important as it is the hottest part of the fermenting mass in a tank.

In all cases where the cooling took place at or about 88 degrees, the tank "went dry" perfectly well, and the resulting wine was drier and far clearer than in case of the wine not cooled and aerated. This was especially noticeable in cases where pure cultures of yeast were used, especially some of the foreign varieties.

In some cases we tried the use of an extra empty tank into which the cooled wine from the first tank pumped was put, and the cooled wine from subsequent tanks was pumped into the first tank. At the end of a certain time the wine first cooled was pumped into the last tank. In this way one avoids cooling the same wine or part of it twice, but an extra pumping is thus necessitated. The avoidance of cooling wine that has just been cooled and pumped back to the top of the tank is certainly an important problem that must be solved by each wine-maker according to circumstances. We would suggest that a storage tank at a greater elevation than the fermenting tank be used as a common receptacle for all cooled wine. As soon as a sufficient amount of wine in any given tank has been cooled, it can be returned by gravity, and thus all danger of wasting energy by pumping the same wine twice through the cooler can be avoided. It is true that there will be an extra amount of labor required to force the cooled wine to a greater level than that of the fermenting tank.

Faults of the Apparatus. It was found that with our first apparatus we had made the mistake of placing the tubes too far apart (2½ inches), losing thereby a very considerable amount of air and spray. This we had to remedy for the time by filling up the space with two-inch slats; but this, of course, caused a great waste of cooling effect. We therefore, in our modified apparatus, recommend that the tubes be placed an inch apart, which is the practical limit for the successful soldering of the tubes into the castings, more especially when the tubes are of such greater width as we now find desirable. The horizontal position, moreover, will always prove a source of waste on account of allowing too ready a passage for the current of air and spray. It was also found that for large scale operations the cooling capacity of the apparatus was not adequate.

THE NEW APPARATUS.

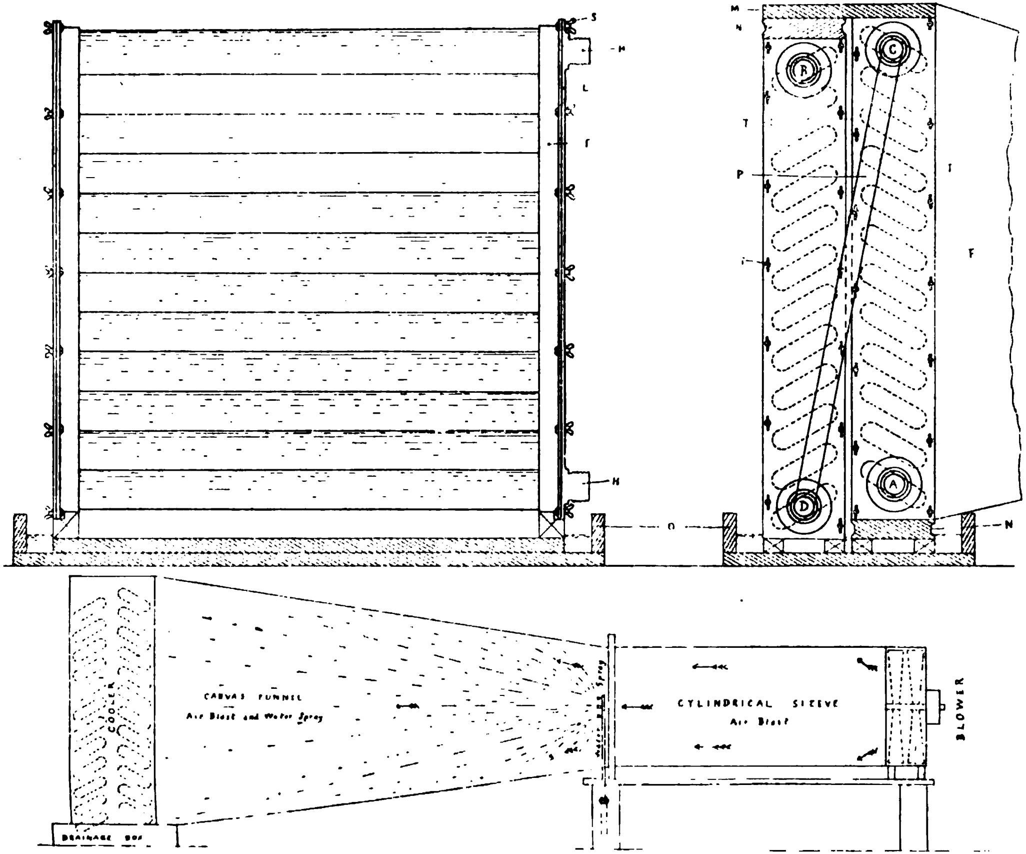
In the construction of the new apparatus the need of greater capacity was first considered. The lengthening of the tubes as in the French model renders it very cumbersome, and it therefore seemed preferable to retain the same length of tubes, but to give them an increased cooling surface by enlarging their dimensions to 5½ x 1½ inches, and to use two batteries or columns placed one behind the other. This arrangement would serve in any case to utilize better the cooling current which must always waste through a single system of tubes however placed. Moreover, the increased cooling surface obtained by widening the tubes does not involve an increase of friction, as would a lengthening of tubes, to attain the same purpose.

Another modification deemed wise is to have the extremities of the tubes closed by a single bronze casting instead of separate castings for each pair of tubes. These castings are fastened by thumb-screws over rubber washers, as in the case of the first machine. The advantages are that it not only requires fewer thumb-screws (and hence allows greater rapidity in cleaning), but also that the solidity of the whole apparatus is greatly enhanced, and the necessity for an extra frame is done away with. We found that with the great number of small castings it was difficult to keep any frame from "giving" a little. (See Fig. 3.)

Relative Position of the Sets of Tubes. In order to determine as nearly as possible the various conditions needful to secure the best results, two sets of tubes of twelve each were placed in a convenient frame, and so suspended on chains that both their distance and their relative positions could be readily changed at will. While this would not enable us to determine exactly all the best conditions in the completed arrangement, it would at least enable us to avoid such mistakes as rendered the first apparatus to some extent unsatisfactory.

It soon became apparent that so long as the tubes in the two sets were placed parallel to each other, whether horizontally, or inclined upwards or downwards, even when arranged as closely as practically possible, and so as to break joint, there was a great waste of spray, and therefore of cooling power, in the rear of the second column. The obvious remedy was to place them at an angle to each other, so that the current should be considerably checked and its direction completely changed before being allowed to emerge at the rear end of the apparatus. It remained to be determined whether the relative inclinations should be in the form of a V or of an A, and what the angle of the inclination should be. It was evidently not desirable to make this angle steeper than necessary to accomplish the purpose.

Points observed. In making the experiments the points observed were: First, the absence of any considerable waste of spray beyond the second column; second, the approximate equality of the drip of water from both sets; third, the diminution of temperature obtainable with varying strength of spray and blast. We could thus as nearly as possible estimate the results likely to be obtained by the apparatus when completed. In all experiments so far made the two sets were placed as near together as practically possible. As to the first point it was found that the least waste of spray occurred when the tubes were placed one inch apart in the inverted V (A) position, and that for this purpose an angle of 30 degrees was sufficient.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COOLER
CANVAS FUNNEL
Air Blast and Water Spray
Water [illegible] Spray
CYLINDRICAL SLEEVE
Air Blast
BLOWER
DRAINAGE BOX

Fig. 3

Second, it was further found that under these conditions the drip from the two sets of tubes was most nearly equalized, and that their entire surfaces remained well wetted.

As regards the third point, it was found that in the space between the two sets the temperature was mainly governed by the strength of the blast and the amount and kind of spray used. In this respect our preliminary experiments could give only comparative values, since the saturation of the air at Berkeley at the time was between 75 and 80 percent, and the air temperature varying but slightly above and below 60 degrees F.

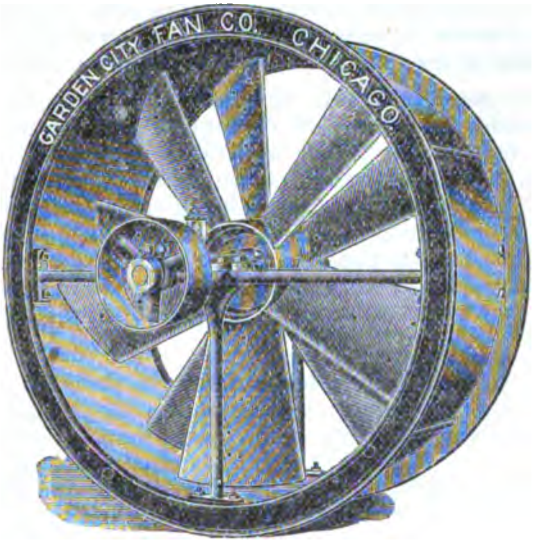
GARDEN CITY FAN CO. CHICAGO

Fig. 4. Blower.

Air Blast and Spray. No mechanical power being available at the time at Berkeley, we had to restrict ourselves in the use of the blower to such a velocity as could be obtained by the power of two men, which was between 700 and 750 revolutions per minute, obtaining probably about ⅔ to ¾ of the effect of the blower, or about 2000 or 2500 cubic feet per minute.

It was quickly noted that as transmitted through the pyramidal canvas sleeve directly, the distribution of the wind over the surface of the tubes was very unequal, being very strong at the circumference and almost null in the middle, on account of the centrifugal action of the blower. This inequality was effectually done away with by the interposition between the blower and the pyramidal sleeve of a cylindrical sleeve 3½ feet long.

As regards the spray, a comparison of the reduction of temperatures obtained with the rather coarse spray heretofore employed, with that obtained from a standard cyclone nozzle yielding very fine spray, showed that the latter was by far the most efficacious, besides which it permits of a shortening of the pyramidal portion of the sleeve on account of the rapidity with which evaporation can take place. To attain this end, however, it is necessary that the pressure should be sufficiently high, that is nearly such as is obtained with spray pumps—not less. Manifestly the coarse spray carried with it too much of the original high temperature of the water. It was also found, however, that a single nozzle of this kind does not yield a sufficiently large quantity of water, and that therefore a combination or battery of such nozzles should be used, *varying in number according to the water pressure and the strength of blast at command.* In our apparatus we have adopted five as probably sufficient.

It is easy to so arrange the battery of nozzles as to conform to the flare of the pyramidal sleeve, in order *not to waste the spray upon the canvas* on the one hand, nor to leave part of the space unutilized on the other.

Beneath the apparatus should be placed a shallow box to catch the drip, which should be drained off through a pipe or trough. A screen may be placed in the rear of the apparatus to catch the spray that has passed through, and may be of boards, sacks or anything that is convenient. If the apparatus be placed facing a door or window, no screen is necessary. The current of air in itself is not objectionable in a hot winery. The drawback to the free circulation of the current of air and spray is that the workmen working immediately in front of it after coming from some hot part of the cellar are in danger of contracting colds or even pneumonia.

Conclusions. Accepting, then, the fact that in California the tendency is to ferment at high temperatures on account of the initial, as well as the air, temperatures being higher than in cooler countries, such as the Medoc, Burgundy, the Rhine, Champagne, etc., and also the fact that in this State we use exceptionally large fermenting tanks, and that our musts are, as a rule, very high in sugar and in many cases low in acid, the simple question is: Shall we not attempt to overcome these natural defects of our climate, and control fermentation just as wine-makers of other countries do under similar circumstances, and as the brewers have long done under all circumstances?

Competition is now so keen that if we would succeed we must place on the market a wine that is equal, if not superior to, that of other countries. Under favorable conditions we produce a wine that is equal to any in the world, but under unfavorable conditions we make wines that are distinctly inferior.

It is the custom at all the wineries of the State, in case of the tank threatening to "sick", to pump the wine from the bottom over the top, at the same time aerating it by causing it to fall in a spray. Should the cooling apparatus be used in connection with this procedure, there would be *no extra cost beyond the original expense of the apparatus*, which will last indefinitely with proper care.

An apparatas such as we recommend will cost very little compared with the enormous saving that can be effected in a single unfavorable season. To provide several for use at a large winery should not cost over $1,000, while for a winery of ordinary size an apparatus capable of reducing the temperature of the wine a minimum of 10 deg. at the rate of 1,000 gallons per hour, would cost far less. Messrs. Müntz and Rousseaux found that the cost of cooling wine in France with their cumbersome apparatus was 1/13 of a cent per gallon. This includes four men at 70 cts. per day for pumping, and the wear and tear, interest on the original cost of the apparatus, and all possible extra expenses. It would not cost much over 1/12 of a cent per gallon in this country, even if we had to buy a $200 motor (2½ H. P.) in addition to the apparatus itself. It need not cost any more than this, for the motor takes care of itself when once started, and any extra horse power could be used to advantage in pumping wine from one tank to another.

In conclusion we wish to express the sincere thanks of the University to those who helped us with suggestions, money and material.

Messrs. Toulouse and Delorieux, of 622 Commercial street, San Francisco, constructed the apparatus according to our designs, and it is due in no small degree to the extra time and trouble bestowed by them upon its construction and modifications that the experiments proved successful.

Mr. D. M. Doub, of 137 First street, San Francisco, came forward in the most public-spirited manner, loaning us several of the "blowers" and "exhaust-fans" needed. But for such liberality the experiments could not have been undertaken.

The Pelton Water-wheel Co. also helped us not only with the loan of machinery, but also by making for us on the shortest possible notice such alterations as were suddenly found necessary.

Mr. J. Henshaw Ward provided for our exclusive use at the Natoma Vineyard $150.00 worth of the best wine hose, not otherwise obtainable.

Mr. J. H. Wheeler and Mr. J. Rennie, the lessees of the Natoma Vineyard, allowed us to use part of the vintage and cellar.

To Mr. Wm. Wehner of Evergreen we are especially indebted, not only for the use of the cellar, vintage, laborers, etc., but for the hospitality and attention he bestowed upon us. The kindness and assistance we received at his hands was exceptional.

Descriptions of the apparatus used abroad are given alongside of the form we have devised, so that the wine-maker may choose between them.

All that we desire is that some kind of effort shall be made to control temperatures, be it the use of ice, water, air or anything else; for it is certain that if the temperature is controlled there will be an improvement of from ten to one hundred percent in the quality of Californian wine.

The Viticultural Staff of the College of Agriculture will cheerfully confer and advise with any persons interested in this subject, and assistance in the construction or working of coolers of any sort will be given. While we think that our apparatus is better than any of the rest, all that we desire is *that there be some sort of cooling apparatus used*, and if our efforts contribute to the attainment of this end, we will be satisfied.

LOUIS ROESCH CO., PRINTERS, S. F

them claims of inventing the process described above, or the right to charge the public for any similar bleaching formula, or for attempting to use the same on nuts:

> Nothing stated therein can do away with the simple statement that the application of the chlorine bleaching process to nuts was my invention and not Mr. Farrall's, and that it was published in August, 1896, for the public benefit. With it went the right of the public to use any of the old, well-established modifications of chlorine bleaching, such as the addition of acids at any time the user might desire to hasten the process. Although this was not mentioned in our publication, it was actually done in this laboratory, but on the small scale on which we experimented it did not seem to offer any advantages over a somewhat longer treatment with the simple solution. If in operations on the large scale such an advantage appeared, it could not form the basis of any legitimate patent on a process fifty years old at least.
>
> The Assistant Commissioner's ruling will not stand for a moment in a court passing upon the merits of the case. The first claim as set forth in Mr. F.'s patent looks like an attempt to stultify the Patent Office; it is worded almost verbatim like the prescription given as far back as 1837. The Assistant Commissioner, in omitting all reference to our Bulletin 113, ignores the fundamental fact that I originated the use of chlorine-bleaching nuts, and assigns the credit therefor to the patentee.
>
> I can not consent to this attempt to exploit for private gain an idea freely given to the public by this Station; and I shall do all I can to maintain for the nut-growers the free use of whatever is involved in the well-known processes of bleaching with the hypochlorite solutions, in all their modifications.

It is a significant fact that, when the above letter has once been seen by the representatives of companies claiming the invention and the right to collect charges from those using the formula, they never present themselves to him again and apparently give up the idea of trying to sell or collect upon a "*secret formula*" of this description.

Summary.—1. The application of the old-established chlorine-bleaching processes are not patentable, because the process was published in August, 1896, by this Station for the benefit of the public.

2. The difference between the bleaching liquid or dip of this State and those elsewhere offered lies in the simple fact that the loosely combined chlorine of the older ones is set free by the use of vinegar in the newer processes. A five-minute-acting dip is thus converted into a five-second one; and the reason for such quick-acting solutions lies in the necessity for getting many carloads of nuts into marketable shape at or about one time. But the use of vinegar itself is a quarter of a century old.

3. The tests made in the laboratory of this Station showed that a mineral acid could with perfect safety be used in place of the vinegar, which is a weak vegetable one; that *less* of the mineral acid gave excellent results, thus preventing the weakening of the solution.

4. The *limit* of the usefulness of the quick bleaching solutions was, approximately, fixed, even when used upon *culls* on which the stains had dried for over two years—good results were obtained when the solution was used as many as four times.

5. The advantages or gains to be had from the use of the new dip have been shown in practice to be due to the great *saving of time;* the newer "dip" taking only from one thirtieth to one sixtieth the time required for the same work by the older ones. Further, by extending the use of this new dip by saving it and applying it to new lots of nuts over and over again, it has been proved in commercial operations that *one part* will bleach perfectly over twenty times its weight of nuts.

6. The chemistry of the solution demonstrates that the process is absolutely harmless, and when operated according to recommendation upon perfect nuts there is no evidence left, other than that *desired,* that the nuts have been treated.

VITICULTURE AND OLIVE CULTURE.

PRESERVATION OF UNFERMENTED GRAPE-MUST.*

By Frederick T. Bioletti and A. M. dal Piaz.

The use of unfermented grape-juice or "must" as a beverage, both in health and in sickness, has been common in vine-growing countries from time immemorial. It has, however, until lately been restricted to the immediate vicinity of the vineyards and to the season of ripe grapes. This is owing to the great facility with which fruit juices of all kinds spoil within a few days after being expressed from the fruit, unless preserved artificially. The great progress made within the last few decades in methods, both legitimate and illegitimate, of food preservation, has made it possible to keep grape-juice for an indefinite period, and to make use of it as a beverage at all seasons and in all places. Accordingly the manufacture of grape-must has attained notable proportions in some European countries, and in some parts of the United States. Its use, however, has up to the present day been almost exclusively medicinal, although it is one of the most wholesome and agreeable beverages known, in health as well as in disease. The cause of this restricted use is twofold. In the first place, in order to simplify and cheapen the processes of manufacture, injurious preservative agents have been made use of by the ignorant or unscrupulous; and, in the second place, the lack of the necessary special knowledge and technical skill has resulted in many failures of attempts to preserve the must in a legitimate manner, so that the price has been necessarily too high for the regular consumer.

It is to remedy this lack of knowledge on the part of the manufacturer, to warn the consumer against the injurious effects of antiseptics, and to call attention to the merits of this delicious beverage, that this bulletin is written. More stress is laid on general principles than on actual methods, as the methods will vary considerably according to the scale on which the manufacture is conducted, and according to the facilities and appliances at the disposal of the individual manufacturer. The business can be conducted profitably with either small or large quantities, but must necessarily be commenced on a modest scale by the inexperienced. The directions given here should enable almost any grape-grower to commence operations, and gradually, as he acquires confidence and skill, to engage more largely in what should be an important industry in California.

Composition of Grape-Must.—A consideration of the following table, showing the constituents of the normal juice of ripe grapes, will make clear its value as a nourishing beverage in health, and also its therapeutic efficacy in certain cases of disease:

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* The edition of this Bulletin, No. 130, has been exhausted, and hence its republication here has been thought advisable.

	Parts in 1.000.
Grape sugar (dextrose and levulose)	180 to 280
Free organic acids (tartaric, malic, and tannic)	1 to 10
Salts of organic acids (cream of tartar, potassium malate, calcium tartrate, calcium malate)	4 to 8
Ash (containing potassium, sodium, calcium, magnesium, ferric oxid, phosphoric and sulfuric acids)	3 to 5
Nitrogenous matter (proteids, amido-compounds)	3 to 10

This table shows that some of the principal constituents of wine, such as alcohol, glycerine, etc., are totally lacking in pure grape-juice; and it is to be noted that it contains no unwholesome substance of whatever kind.

Grape-juice should and can be delivered to the consumer so as to contain no other substances than those shown above. If chemical analysis shows any other ingredients, a fraud has been practiced; and as all the additions usually made are in the nature of antiseptics or preservatives, they are all more or less injurious. All the antiseptics used are easily detected by more or less simple chemical tests, and if an effective pure-food law were in operation it would be easy for the consumer and the honest producer to protect themselves by occasional chemical analyses of the various brands of grape-must on the market. In the larger European countries, where such laws do exist, the use of injurious adulterants is rendered dangerous, if not impossible.

An analysis of a pure grape-must made by a government chemist in Austria, and one of must put up by Swett & Son, at Martinez, made by Mr. G. E. Colby at this Station, gave the following results:

ANALYSES OF GRAPE-MUST.

	Austria.	California.
Solid contents by spindle (Balling)	21.62%	20.60%
Alcohol	none.	none.
Total acid (as tartaric)	.78	.53
Volatile acid	.01	.03
Grape sugar	19.62	19.15
Cream of tartar	.61	.59
Free tartaric acid	.03	.07
Ash	.37	.19
Phosphoric acid	.02	.04

No cane sugar, starch sugar, or antiseptics were found in the California or the Austrian musts. Artificial (anilin) coloring matter, salicylic, benzoic, and boracic acids, formalin and fluorids were tested for in the California must, but none were present.

This is approximately what should be shown by any pure grape-juice. It is instructive to compare this with some partial analyses, made at this Station, of some of the beverages offered to the consumer in California under such titles as "Unfermented Wine," and "Pure Grape-Juice," recommended for invalids and for communion purposes:

SAMPLE 1—"UNFERMENTED WINE."

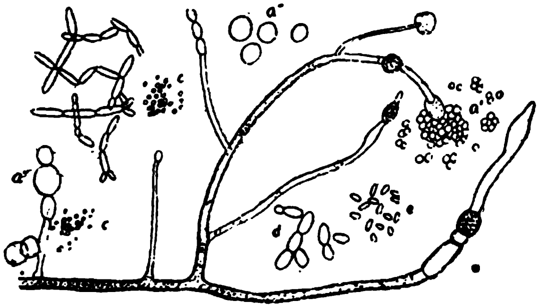
	Per Cent.
Solid contents by spindle	22.00
Total acids (as tartaric)	.59
Sulfurous acid (antiseptic)	.06

SAMPLE 2—"GRAPE-JUICE."

Solid contents by spindle	20.80
Alcohol, by volume	2.00
Salicylic acid (antiseptic)	3.90

The first sample was sold as a "curative for throat and lung troubles." The amount of sulfurous acid it contained was sufficient to *cause* throat and lung as well as digestive troubles in a healthy person. The second sample was sold as "pure unfermented grape-juice," but besides containing a large amount of the injurious antiseptic salicylic acid (more than twenty times as much as was necessary to preserve it), it contained two per cent of alcohol. Even healthy persons, much more invalids, would contract severe indigestion from the use of such a product, which is a fraud upon the public.

Causes of Spoiling.—In order to make clear the nature of the problem which must be solved in order to preserve grape-juice indefinitely, a short account of the causes of spoiling will be useful. When grapes, or any fruits, are gathered, the surfaces in contact with the air have the spores of various fungi, yeasts, and bacteria adhering to them. All these spores are microscopic, but an idea of their appearance, when sufficiently enlarged by the microscope to be visible, may be obtained by reference to Fig. 1, which shows various forms of these organisms developed on the skin of a Muscat grape.



a, a′, a″. Various forms of a mold (*Mucor*).
c, d, e. Various forms of yeasts, molds, and bacteria.

Fig. 1. MICRO-ORGANISMS ON GRAPES.

When the grapes are crushed and the juice expressed, the latter will be contaminated by these spores, washed off the skin. In the air they are dry, and therefore inert; but very soon after they are surrounded by the must, which is a very favorable medium for their growth, they assume an active form and commence to multiply. If the must is warm, this change to an active state occurs very soon and the consequent increase in numbers is proportionately rapid. If, on the contrary, the grapes and therefore the must be cool, the increase is much slower; but, eventually, if left alone the organisms increase until the must ferments. This fermentation consists principally in the changing of the grape sugar into alcohol and carbonic acid, and is the essential part of the process which changes grape-juice into wine.

The main object, then, of the producer who wishes to place "pure unfermented grape-juice" upon the market, is to permanently prevent this fermentation. Besides this, the grape-juice must be quite clear, in order to present an attractive appearance to the consumer.

To attain the first object there are two general groups of methods, which may be called respectively *chemical* and *physical.* All the chemical methods consist in the addition of germ poisons or antiseptics, which either kill the microscopic organisms of fermentation or permanently prevent their growth and increase. Of these substances the principal used are, besides salicylic and sulfurous acid already mentioned, boracic acid, ammonium fluorid, saccharin, and, of late, formalin. Many patent preservatives are found on the market, but they nearly all contain one or more of these substances as their active principle. They are all injurious to digestion and in other ways; and it may be said in general that *any substance which prevents fermentation will also interfere with digestion*, and is therefore to be avoided.

The *Physical* methods work in one of two ways: they remove the germs by some mechanical means, such as a filter, or a centrifugal apparatus; or they destroy them by heat, cold, electricity, etc. The methods which depend upon the removal of the germs are inapplicable, as this can not be done thoroughly except with very small quantities of liquid, and the minute organisms with which we have to deal will soon increase sufficiently to spoil the liquid, if a single one escapes the filter. One yeast-cell, for instance, at ordinary temperatures will increase to tens of millions in three or four days; and if the temperature is warm the increase will be still more rapid. We are, then, reduced to those physical methods which destroy the germs; and of these the only one which has been found useful in this connection is the use of high temperatures. This method depends on the fact that when a liquid is heated to a sufficiently high temperature all organisms present are killed. This temperature is called the "death point," and differs for each particular variety of organisms. The death point will also differ according to the composition of the liquid in which the organism is immersed. Yeast, for instance, is killed at a lower temperature in must than in water, on account of the acidity of the former. Time, also, is a factor in determining the death point. An organism may not be killed if heated to a certain degree quickly and as quickly cooled; while if it is kept at that same degree for some time it will be killed. Some tests made at this Station with a pure* yeast isolated from a California wine illustrate these facts. The yeast was placed in must which had previously been completely freed from all germs, and was heated to various temperatures for various lengths of time, with results as follows: The initial temperature of the must was 20° C. (68° F.) and the yeast was killed by heating it gradually up to 60° C. (140° F.) in fifteen minutes; that is to say, the time taken to bring the temperature from 20° C. (68° F.) to 60° C. (140° F.) was fifteen minutes, and at the end of this time the must containing the yeast was allowed to cool in a room at 20° C. (68° F.). This same yeast was not killed when heated in twenty-five minutes from 20° C. (68° F.) to 50° C. (122° F.), nor even when kept at the latter temperature for five minutes longer. But when kept at this temperature for ten minutes longer, all the yeast cells were killed. Another test with the same yeast showed that if heated from 20° C. (68° F.) to 45° C. (113° F.) in twenty minutes, and then kept at the latter temperature for twenty minutes, few or none of the yeast-cells were killed, though in thirty minutes most of them were rendered incapable of growth. However, even in the last case some were left alive and ultimately spoiled the must. We learn from these tests that heating to 45° C. (113° F.), even for a somewhat prolonged time, can not be depended upon to sterilize grape-must, and that even 50° C. (122° F.) requires too much time to be practical. A heating to 60° C. (140° F.), however, would probably be quite safe, provided that only this particular variety of yeast were present in the must. In practice, however, we have an unknown number of kinds of micro-organisms present, and some of them may be able to withstand a somewhat higher temperature than this.

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* Pure in this case means a yeast consisting of only one variety of micro-organism.

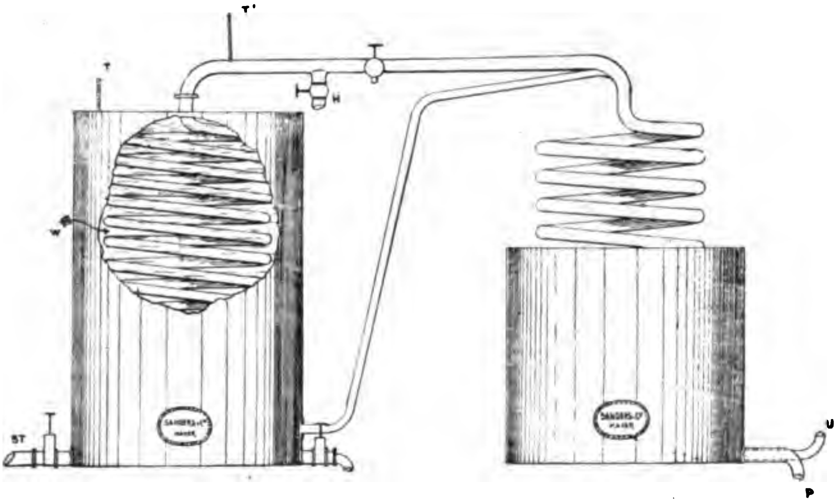
It must be kept in mind also that fungi, including yeasts, exist in two states: the vegetative or growing state, and the spore or resting state. The latter is more resistant than the former; and it has been found that yeast spores, for instance, to be killed must be heated about 5° C. (9° F.) higher than the same yeast in the growing state. The above tests were made with yeast containing no spores; but, as in practice, spores may be and undoubtedly usually are present, a temperature 5° C. (9° F.) higher than indicated would be necessary. Practical experiments made at this Station indicate that must can be safely sterilized at a temperature of 75° C. (167° F.) or 80° C. (176° F.) if all the precautions indicated below are observed. At this temperature the flavor of the grape-juice is hardly changed, though between 90° C. (194° F.) and 100° C. (212° F.) it is slightly affected.

Another property of fungi and their spores, which is of importance in this connection, is their great resistance to heat when dry. Yeast can be heated in a dry state to a temperature above that of boiling water without being killed; the spores of some fungi (*e. g.*, common mold) are even more resistant. The bearing of this upon the preservation of must is that, during the final sterilization which takes place in glass bottles or similar vessels, portions of the inner surface of the cork and of the bottle above the liquid are comparatively dry; and if any spores should be adhering to these parts there is danger that they will not be killed, and that afterward, when they come in contact with the must, they will grow and cause fermentation or mold. For this reason both the bottles and the cork must be thoroughly sterilized *before* being used. This can be accomplished for the bottles by boiling them for at least half an hour after thorough washing, and then allowing them to drain in a place where they are exposed to no draughts or dust. This boiling should be done as short a time as possible before filling the bottles, and they should be handled carefully, taking care not to touch their mouths, for with the greatest care the hands can not be kept free from mold spores. To sterilize the corks this method is not always sufficient, as spores that may be in cracks are liable to escape. For sterilizing the corks, some closed receptacle should be used which will safely withstand considerable pressure. The corks when placed in this receptacle can best be sterilized by steam under pressure, which is allowed to flow in until the pressure, as shown by a gauge, is at least ten pounds. This pressure indicates a temperature of about 115° C. (239° F.), and should continue for at least twenty minutes.

Apparatus Required.—The apparatus necessary for preserving grape-must on any but the very smallest scale consists of: (1) a continuous pasteurizer; (2) a pressure filter; (3) a pressure sterilizer for corks (this may be dispensed with); (4) a bottle pasteurizer; (5) a boiler for pressure steam. Certain other utensils are, of course, necessary, but they are such as are found in almost every wine-cellar.

The Manner of Operating.—The method of proceeding is as follows: Sound, clean grapes, preferably those having high natural acidity, are picked carefully, while cool, into clean boxes. They should not be too ripe, or the must will be too sweet and difficult to clear. They should be crushed as soon as possible after picking, and the juice run into perfectly clean puncheons or other receptacles which have been previously steamed. If the must is cold—15° C. (59° F.) or under—it may be safely left to settle for twenty-four hours or more. This settling is an advantage, as it rids the juice of most of the floating solid matter, and facilitates the subsequent filtering. During this settling the must should be closely watched, in order to anticipate even a commencement of fermentation. After this settling, when the must has become almost clear, it is run through a continuous pasteurizer, one form of which is shown in Fig. 2.

It is heated in this to 80° C. (175° F.) and should come out cool, not warmer than 25° C. (77° F.) and should pass into fresh settling receptacles. For this purpose puncheons or other casks may be used, if they have been thoroughly sterilized by steam, though the best receptacles would doubtless be casks or vats of metal lined with enamel, such as are now made. The greatest care must be taken to avoid contamination of the must as it flows from the pasteurizer. It should pass directly, by means of a block-tin pipe, from the pasteurizer into the receiving casks. The end of this pipe should be thoroughly sterilized by plunging into boiling water, and should never be allowed to touch the hands or any exposed surface. When a receiving cask is full it should be closed immediately with a wooden bung, sterilized previously in the way already described for corks. If all these operations have been conducted with the requisite care, and the casks kept in a cool cellar, the must will remain without fermenting for many days or even weeks. During this time it deposits more or less sediment which has been formed in heating. It is then ready for filtering.



ST. Steam pipe.
W. Water bath.
H. Outlet for hot pasteurized must.
P. Outlet for cooled pasteurized must.
U. Inlet for unpasteurized must.
T, *T'*. Thermometers.

FIG. 2. CONTINUOUS PASTEURIZER.

Filtration.—This filtration is best accomplished by means of a filter so constructed that the must passes upward through the filtering medium, under pressure. Such a filter, made by the International Filter Company of Chicago, is shown in Fig. 3.

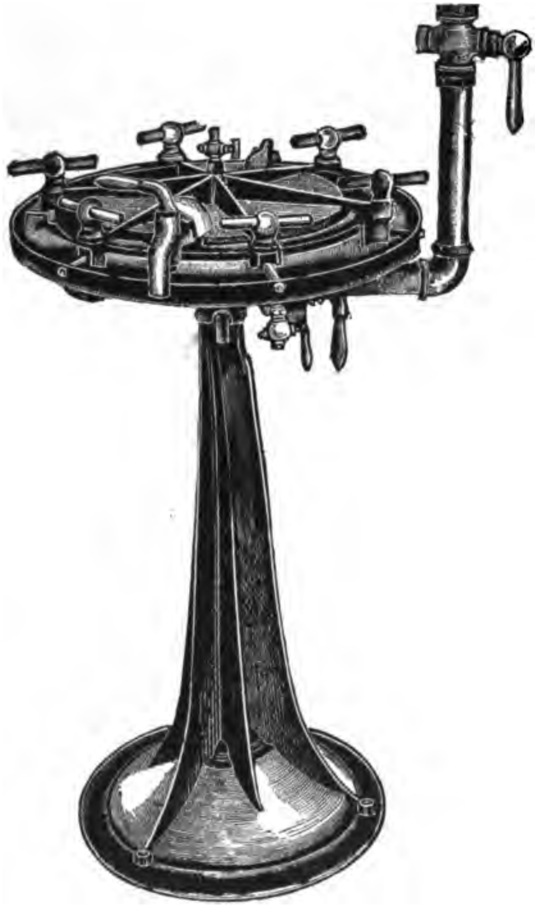


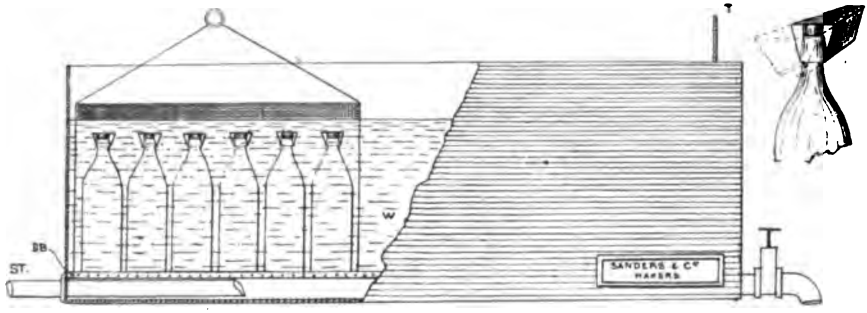
FIG. 3. FILTER FOR CLARIFYING MUST.

This filter consists essentially of two shallow bowls clamped together mouth to mouth, with the filtering medium between them. The unfiltered must enters the lower bowl through the pipe on the right of the figure, passes through the filtering medium into the upper bowl, and makes its exit when clear through the faucet a little to the left of the middle of the figure. The small faucet at the bottom of the lower bowl is for the purpose of cleaning the filter. Occasionally, when filtration becomes slow, this faucet is opened for a few moments. This allows the sediment accumulated at the bottom to escape and at the same time the entering must takes a rotary course in the lower bowl, thus cleaning off the surface of the filtering medium; so that when the cleaning faucet is closed filtration proceeds as before. On a large scale, a filter press, such as is used in large wineries and in beet-sugar factories, might conveniently be used.

It is impossible to prevent a certain amount of contamination by fungous spores during filtration; but it should be minimized as much as possible by the greatest cleanliness, and attention to sterilizing everything with which the must comes in contact. In this regard it should be kept constantly in mind that in an ordinary room or cellar, where there is little dust, there is comparatively little danger of contamination from the air, the main danger being from the solid surfaces with which the must comes in contact. The must may be bottled directly as it flows from the filter, or it may pass into a sterilized temporary receptacle, from which it is bottled. It should, however, be placed in its final receptacles (bottles, etc.) the same day on which it is filtered, corked immediately, and sterilized finally as soon as possible, preferably within twenty-four hours.

Final Sterilization.—On account of the re-contamination during filtration, a final sterilization must be made after the bottles are corked. This is accomplished by means of a bottle-sterilizer, which the producer himself can construct. A simple and efficient form is shown in Fig. 4.

It consists of a wooden box or trough provided with a wooden grating placed about two inches from the bottom. The bottles, after being filled with the filtered must and corked, are placed in perforated or wire baskets, which rest upon the grating. The trough should contain enough water to completely submerge the bottles. The water should be kept at a constant temperature of about 85° C. (185° F.) by means of a steam coil placed beneath the grating. The bottles should be left in this pasteurizer for exactly fifteen minutes if they are one-quart champagne bottles. For other sizes it is necessary to make a test with a bottle of must in which a thermometer has been placed, in order to determine how long it takes for the entire contents of the bottle to reach the required temperature. It has been found at this Station, that although the must in the upper part of a quart champagne bottle reaches 75° C. (167° F.) in eight minutes, when surrounded by water at 85° C. (185° F.) it requires fifteen minutes before the must at the bottom of the bottle acquires that temperature. The sterilization in bottle should be conducted at a temperature at least 5° C. (9° F.) lower than that reached in the continuous pasteurizer. Thus, if the water in the first case was kept at 90° C. (194° F.) or 95° C. (203° F.) and the must attained a temperature of 80° C., the water in the bottle pasteurizer should be kept constantly at 85° C. and the time of pasteurizing so chosen that the must in the bottles will attain a maximum temperature of 75° C. (167° F.). *If the final heating is higher than the first, it may cause a precipitation of solid matters, which will make the must cloudy in the bottles.*



DB. Double bottom. *ST*. Steam pipe. *W*. Water bath. *T*. Thermometer.
(Bottle shows method of adjusting a cork-holder of sheet metal.)

FIG. 4. CORK CLAMP AND PASTEURIZER FOR MUST IN BOTTLES.

During this sterilization in bottles the corks are liable to be expelled by the pressure developed. To prevent this they may be tied down with strong twine; but it is a great saving of time and labor to use some such contrivance as that illustrated in Fig. 4.

By this operation the must is thoroughly sterilized and will then keep unchanged for years, or until the bottles are opened. If, however, the bottles are to be capsuled, or kept in a very damp place, there is one other cause of spoiling that must be guarded against. However carefully all the various operations are conducted, there are sure to be mold spores on the upper surface of the cork. If this surface remains dry these spores will not grow, and are harmless. But when the cork is covered with a capsule the space between the capsule and the surface of the cork finally becomes moist, and any spores there will develop. Some molds have great penetrating power and may force their way either through the cork, or between the cork and the neck of the bottle (especially if the very best quality of corks has not been used) and finally reach the must. The molds which enter in this way do not, as a rule, grow into the liquid, on account of the small amount of air present; but they make a moldy layer on top, which lessens the selling value of the must, if it does not actually spoil it. This danger can be avoided by dipping the top of the neck of the bottle into a two per cent solution of bluestone and water, in such a way as to wet the upper surface of the cork, before putting on the capsule. The same object may be attained by dipping the neck, in the same way, into very hot, melted paraffine. The bluestone acts by killing any spores that may be on the cork or which may find their way there later. The heated paraffine kills the spores present, and prevents later infection by completely covering the cork and keeping it dry.

The quality and character of the grape-juice prepared in this way will vary greatly according to the variety of grape used; and a pleasing variety may be obtained by using, partially or wholly, grapes of high aroma, such as Muscat, Isabella, etc. The color will, however, always be white or yellowish except with a few grapes, such as the Bouschets, which have pink or red juice. Red must, however, can be obtained by a modification of the process described. If the must, after it passes through the continuous pasteurizer, is allowed to come out hot and flow into a vat containing the skins of red grapes, almost any desired depth of color may be obtained, depending on the variety of grape used and the time during which the hot must is left in contact with the skins. Must prepared in this way, however, differs in other respects than in color from the white must. Besides coloring matter various substances are extracted from the skins, the principal being tannin. This makes the composition of the red must more like that of red wine, though of course it still contains no alcohol. A grape-juice of this character might appropriately be called "Unfermented Wine," and would doubtless be useful in medicine, as it would possess certain tonic properties not found in the white must. The regular consumer, however, would in all probability generally prefer the white must.

Grape-must, containing as it does generally from twenty to twenty-four per cent of sugar, is too sweet for many palates and constitutions, but it may be diluted with water by the consumer to any desired extent; and a mixture of equal parts of grape-must and carbonated or mineral water makes a beverage much appreciated by many people. In Europe a certain amount of sparkling grape-juice is put up, *i. e.* grape-juice which has been carbonated, or charged with carbonic acid gas. This, though an addition to the natural juice of the grape, can not be looked upon in any sense as a fraud or adulteration, and makes the beverage more palatable to many; besides if properly done it has no injurious effects on the health of the consumer.

In conclusion, the following brief summary of the main precautions to be observed in the manufacture of unfermented grape-must may be useful:

1. Only clean and perfectly sound grapes should be used.
2. The grapes should be picked and handled when cool.
3. The greatest cleanliness is necessary in every stage of the process.
4. All utensils and apparatus used should be cleaned and sterilized immediately before using, and as short a time as possible after using.
5. The last sterilization should be at a temperature at least 5° C. (9° F.) lower than the temperature used in the first sterilization.
6. Reliable thermometers should be used, and the temperature watched very carefully.

BENCH-GRAFTING RESISTANT VINES.

(Bulletin No. 127.)

This bulletin, issued in 1900 by Messrs. F. T. Bioletti and A. M. dal Piaz, and not reprinted because still available for distribution, reviews the history of the introduction of the resistants into California and the lack of success. The work of the Experiment Station with these vines is then taken up and the results of the culture tests are given, together with the various methods of grafting and callusing, planting grafts in the nursery, and comparative experiments in rooting cuttings of resistant stocks. The following is the summary of results and conclusions:

1. Every grape-grower should insure against phylloxera by testing the most promising resistant vines on his own place, and by learning the methods of bench-grafting.
2. It is unsafe to attempt operations on a large scale with cuttings imported from abroad, on account of the danger of injury to such cuttings on the journey.
3. A cutting-graft of suitable varieties makes as large and vigorous growth as a simple cutting, so that by the method of bench-grafting no time is lost in establishing a resistant vineyard.
4. Resistant varieties which are difficult to root but easy to graft when old, such as Lenoir, should not be bench-grafted.
5. Care in callusing, planting, and treatment in nursery, and especially in keeping the grafts moist from the time they are made until they are in the callusing bed, will enable even an inexperienced grafter to obtain at least 60 per cent of good, grafted plants in suitable locations.
6. The bluestone should be washed off the outside of the raffia before tying, or it will injure the bark of the graft.
7. Callusing in sand insures more perfect unions and a larger per cent of successful grafts than planting directly in the nursery.
8. The moisture in the callusing bed should not be excessive, and the temperature should be relatively warm.
9. The growing grafts should be watched closely, in order to see that the roots of the scions are removed before they become large, and that the raffia is cut before it strangles the graft.
10. The English cleft graft is preferable to the Champin graft, because it gives more perfect unions and can be made with more accuracy and rapidity.

11. Scions of two eyes are preferable to those of one eye, as they give more chances of success.

12. Rupestris St. George seems to be remarkably adapted to California soils (except the heaviest clays) and conditions, and is to be preferred to any variety yet tested here wherever deep penetration of roots is possible and desirable.

13. All the eyes of the Rupestris stock should be cut out deeply and carefully.

14. A vigorous and large-growing Vinifera scion promotes an equally vigorous and large growth of Rupestris St. George used as stock.

REPORT ON THE CONDITION OF OLIVE CULTURE IN CALIFORNIA.

(Bulletin No. 129.)

This bulletin, by A. P. Hayne, was issued in May, 1900, in response to a demand for information on the cause of olive-culture failures in the State. After investigations conducted in various parts of the State, the following conclusions were reached: The causes of failure were found to be among the following:

Cultural Conditions: Improper selection of soils; neglect of tillage and irrigation; neglect of proper pruning; and neglect in fighting insect pests.

Commercial Conditions: Competition with cottonseed oil and others sold as olive oil; poor harvesting and manufacturing methods; and selection of unsuitable varieties.

These several conditions are separately discussed in the bulletin. A chapter on methods of pickling olives is also given. This bulletin is also available for distribution.

UNIVERSITY OF CALIFORNIA PUBLICATIONS.

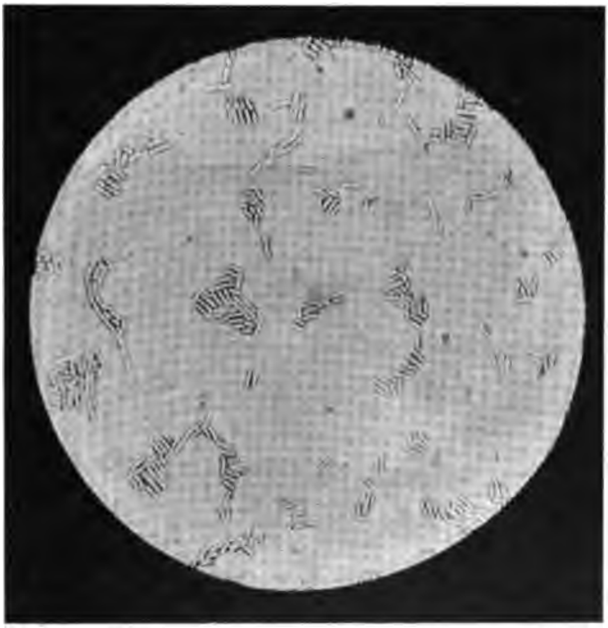
COLLEGE OF AGRICULTURE

AGRICULTURAL EXPERIMENT STATION.

CONTRIBUTION TO THE STUDY OF FERMENTATION.

PART I.

BY E. H. TWIGHT AND CHARLES S. ASH.



WINE YEAST CULTURE.

BULLETIN No. 159.

(Berkeley, June, 1904.)

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1904.

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The Station publications (REPORTS AND BULLETINS), *so long as available, will be sent to any citizen of the State on application.*

Contribution to the Study of Fermentation.

BY E. H. TWIGHT AND CHARLES S. ASH.

The present bulletin is a report upon the coöperative investigations carried on during the vintage of 1903 by the Agricultural Experiment Station of the University of California and the California Wine Association of San Francisco. The Association allowed the use of its large wineries in Sonoma County and built a laboratory in Geyserville 14 by 14 feet for the cultivation of pure yeasts; it also gave the use of its San Francisco laboratory for the analytical work.

The object of these experiments was the study of: (1) The influence of temperature on fermentation; (2) The influence of acid (acidity of must) on fermentation; (3) The influence of selected cultivated yeasts on fermentation as compared with the natural (wild) yeasts; (4) The comparative values of the wines derived from these experiments.

Considerable work of this nature has already been done in foreign countries, principally in France and Algeria; also at this Station.

On the part of the California Wine Association, the observations and analyses reported upon in this bulletin were made by Charles S. Ash, who has charge of its laboratory and who divided his time between its wineries in Sonoma County and its laboratory in San Francisco.

Observations were made on 360 fermentations in tanks of 5,000 gallons capacity each, making a total of 1,250,000 gallons of wine, which therefore puts this work upon a practical basis—and not the result of laboratory investigation only. It is impossible, in a bulletin of this length, to record all data obtained, so only the most characteristic are herein given.

Effect of Temperature on Fermentation.—When the must of grapes is being transformed into wine, a chemical change takes place ($C_6H_{12}O_6 = 2\ C_2H_6O + 2\ CO_2$), increasing the temperature. In the practical fermentation of wine, the temperature varies from 60° to 105° F. The most favorable temperature seems to be about 85° F. When wine was first made in hot countries, it was the ambition of all the savants to produce a yeast that would ferment a large percentage of sugar at a high temperature. These efforts, however, proved to be of little or no value, for it was found that the higher the temperature during fermentation, the greater the amount of acetic, lactic, and other acids formed, and the lower the percentage of alcohol.

Volatile Acid.—Kayser, in France, has given the following figures on the increase of volatile acid when fermentation takes place at higher temperatures:

	25° C. (77° F.).	35° C. (95° F.).
Yeast No. 2	.0979% Volat.	.0780% Volat.
Yeast No. 8	.1112 "	.1504 "
Yeast No. 9	.0862 "	.0824 "

These figures are not very conclusive, since out of the three examples two have not proven his statement. We have experimented very thoroughly on the same lines in our laboratory, with more satisfactory results, as given below:

	At 75° F.	At 85° F.	At 95° F.	At 102° F.
Yeast No. 1	.067% Volat.	.065% Volat.	.097% Volat.	.112% Volat.
Yeast No. 4	.071 "	.073 "	.101 "	.119 "
Yeast No. 5	.059 "	.059 "	.063 "	.094 "
Yeast No. 6	.062 "	.061 "	.070 "	.100 "

This laboratory result was fully confirmed in two cellars in Sonoma County, situated only one and one half miles apart, and handling the same quality and varieties of grapes. We have designated these cellars as "A" and "B":

Winery.	Average Temperature of Fermentation.	Average Volatile Acid.
"A"	80° F.	.078%
"B"	95° to 105° F.	.118%

Albuminoids.—Another great objection to fermenting wines at a high temperature is that under these conditions they will not clear readily. This is due to the large amount of nitrogenous matter (albuminoids) retained in the wine, and is exceptionally disastrous in the case of white wines, on account of their poverty of tannin. A wine with a large percentage of albuminoids is also subject to bacterial diseases.

The following table shows the percentage of nitrogen in wines fermented at different temperatures, taken from Roos and Chabert, two of the best known authorities on the fermentation of wines in hot countries:

	NITROGENOUS MATTER IN WINES FERMENTED AT:			
	25° C. (77° F.).	30° C. (85° F.).	35° C. (95° F.).	40° C. (104° F.).
No. 1	----	.265%	.322%	.460%
No. 2	.115%	.115	.120	.135
No. 3	----	.112	.193	.183
No. 4	.187	----	----	.205

Alcohol.—We now come to the most important factor, from an economical standpoint, in the fermentation of wines: that is, the amount of alcohol produced from a given amount of sugar. Theoretically, 100 parts (100 grms.) of sugar yield:

46.60	Carbon dioxid.
48.40	Alcohol (61% by volume at 15° C.).
3.20	Glycerin.
.60	Succinic acid.
1.20	Used by the ferments.

The following tables on the above subject give the results of experiments conducted in Algeria by Messrs. Roos and Chabert, and they demonstrate that there is a loss in alcohol when wine is fermented at a high temperature:

	25° C. (77° F.).	30° C. (85° F.).	35° C. (95° F.).	40° C. (104° F.).
Must No. 1, 17.4% Sugar	10.0% Alcohol	9.7% Alcohol	9.2% Alcohol	
Must No. 5, 17.4% “	9.9% “	9.7% “	9.1% “	7.3% Alcohol
Must No. 8, 19.0% “	10.9% “	10.9% “	9.6% “	9.3% “
Must No. 11, 20.3% “		9.6% “	7.2% “	6.1% “

The results of Messrs. Roos and Chabert are fairly well confirmed* by us, the following experiments having been conducted in the laboratory of the California Wine Association:

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*See Viticultural Report of California Agricultural Experiment Station for 1883-84-85-86-87, by E. W. Hilgard.

Must No. 1, Carignane, 20% Sugar.

	25° C. (77° F.).		30° C. (85° F.).		35° C. (95° F.).		40° C. (104° F.).	
	Alcohol.	Sugar.	Alcohol.	Sugar.	Alcohol.	Sugar.	Alcohol.	Sugar.
Yeast No. 5	11.3%	.100%	11.2%	.095%	10.8%	.115%	10.4%	.200%
Yeast No. 6	11.2	.105	11.3	.100	10.8	.105	10.3	.195
No yeast added	11.0	.105	11.1	.105	10.5	.180	9.9	.220

Must No. 2, Carignane, 21% Sugar.

	25° C. (77° F.).		30° C. (85° F.).		35° C. (95° F.).		40° C. (104° F.).	
	Alcohol.	Sugar.	Alcohol.	Sugar.	Alcohol.	Sugar.	Alcohol.	Sugar.
Yeast No. 5	12.1%	.105%	12.1%	.100%	11.6%	.215%	10.9%	.290%
Yeast No. 6	12.0	.100	12.1	.105	11.7	.215	11.2	.285
No yeast added	11.9	.115	11.8	.120	11.4	.265	10.6	.500

Must No. 3, White, 25% Sugar.

	25° C. (77° F.).		30° C. (85° F.).		35° C. (95° F.).		40° C. (104° F.).	
	Alcohol.	Sugar.	Alcohol.	Sugar.	Alcohol.	Sugar.	Alcohol.	Sugar.
Yeast No. 5	13.6%	.200%	13.6%	.215%	12.8%	.415%	10.4%	2.10%*
Yeast No. 6	13.4	.210	13.6	.200	12.6	.450	10.8	2.55*

*Stuck.

Dryness.—And, finally, we come to the question of dryness (low percentage of sugar remaining after first fermentation).

Wines fermented at low temperatures (85° F. or under) become dry very quickly, running down as low as 0.100 per cent of sugar within two weeks, while wines fermented at higher temperatures sometimes take over a year to reach this condition. We consider this point next in importance to the amount of alcohol obtained, for upon the dryness of a wine largely depend its keeping qualities. A glance over the table already given, showing the amount of alcohol derived and the amount of sugar left unfermented, will make this point readily understood. The increase of unfermented sugar at high temperatures is even more constant than the increase of volatile acid under the same conditions.

Summary.—Fermentation at low temperatures (85° F. or under) has the following beneficial results:

1. Lower percentage of volatile acid.
2. Lower percentage of albuminoids (easier to clear).
3. Greater percentage of alcohol (from 1 to 2 per cent, according to the deviation in temperature above 85° F., which appears to be the point of most perfect fermentation).

It is easy to recognize the great losses which accrue in sweet-wine wineries from fermentation at high temperatures, especially if it is the ambition of the wine-maker to ferment them as rapidly as possible.

4. Dryness.

Cooling of the Must during Fermentation.—It has been conceded by all authorities that cooling the must is the only practical method of making good dry wines in hot climates. The California Agricultural Experiment Station at Berkeley in the season of 1896 carried on very interesting experiments along these lines, and those interested may find a detailed account in Bulletin No. 117, "The Control of the Temperature in Wine Fermentation," by A. P. Hayne. The cooler described in these experiments had a small capacity, and though the results were satisfactory, it did not come into general use. However, one of these coolers has been used since that time in one of the small wineries where the experiments were conducted.

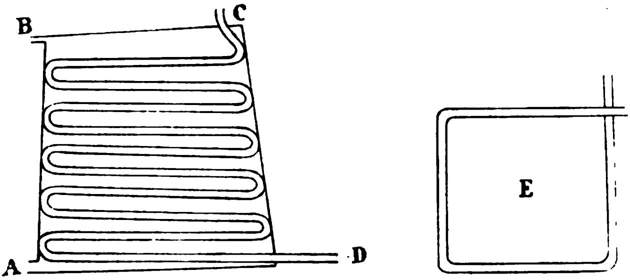

Fig. 1. Wine cooler.

A. Entrance of water. *C*. Entrance of warm wine. *E*. Plan.
B. Exit of water. *D*. Exit of cooled wine.

The only argument that can be made against cooling is the expense, and that in very many instances could be reduced to a very low figure, amounting to practically the cost of pumping the must through a coil.

At Geyserville this year two coolers were built which cooled a 5000-gallon tank of must twenty degrees in thirty-five minutes; cost of cooling estimated at $0.0009, not one tenth of a cent per gallon. These coolers cost $86 apiece. The only other expense was the pumping of the must and cold water through them.

Fig. 1 illustrates the contrivance used at Geyserville, which is extremely simple.

Three hundred and twenty feet of 1½-inch galvanized pipe were arranged in square tiers in a fermenting tank, each arm of this coil measuring eight feet. The warm must was pumped in at the top of the tank and issued from the bottom. The cold water was pumped in at the bottom and passed from the top. It may be of interest to note that in this case it took about twice the volume of water to cool a given amount of wine. The temperature of the water was 60° F.

From our observations at Geyserville, we found that after the must had once been cooled, it fermented out perfectly dry before the temperature again had a chance to rise to the danger point.

As all wineries need a large supply of water for washing the tanks, cleaning the machinery, washing the pomace for brandy, etc., a cooler could possibly be built in the reservoir from which the water is distributed. In many instances where wineries are located alongside of a river or an irrigation canal, the cooler could be placed in the river-bed or the ditch. In the building of new wineries, the advantage of such an acquisition should be considered, as the cooling would only cost the pumping of the must through the coil. With cheap oil fuel, this would be nominal.

Experiments with Cultivated Yeasts.—Under ordinary conditions, the transformation of fresh grape must into wine is spontaneously produced from the micro-organisms (yeasts) that cover the surface of the grapes at maturity. The principal factor in the vinous fermentation is the elliptic yeast (*Saccharomyces ellipsoideus*). The natural yeasts of some varieties of grapes produced very much better fermentation than others. For example, in California the yeasts of Tanat, Burger, Carignane, Mataro, and Alicante Bouschet are very vigorous, while those of Mondeuse, Malvoisie, Zinfandel, and Mission are, as a rule, quite feeble. As most of our red wines are made from Zinfandels, our attention was first called to this grape. After keeping record of the fermentation of all Zinfandels on natural as well as cultivated yeasts, we have come to the following conclusion:

Zinfandels, when fermented on their own yeasts (not mixed with any other variety) ferment very rapidly at first, but when they have fermented down to about 2 to 5 per cent of sugar, the temperature of the must rises very high and fermentation stops for a period varying from a few hours to a whole day. Then (in a good year, like 1903) they become dry. Attached to this report are given some examples of typical Zinfandel fermentations (Figs. 3 and 4). The fermentation is exceptionally irregular, in extreme cases fermenting out as much as 12 per cent of sugar in one day and possibly only 1 per cent the next.

In Burgers and Carignanes, the fermentation is uniform all through (Figs. 6 and 7). The must loses approximately the same percentage of sugar the third as the second day, and so on until the fermentation is finished; or they ferment the greatest amount of sugar the second day and gradually decrease. This is the reason why wine-makers like to mix Carignanes (or Burgers) with Zinfandels (Figs. 11, 12, 13).

WORK AT GEYSERVILLE, VINTAGE OF 1903.

Previous to the vintage, we pursued the following plan: A great many varieties of yeasts were experimented with, pure cultures of all first being made. These pure cultures were obtained by starting from one cell. After they were made they were tested in the same medium and under different conditions in order to select the most vigorous. Our work was carried on with two of these selected yeasts, which we have designated as No. 5 and No. 6.

The inoculations from the pure cultures were made into test-tubes full of sterilized must; then from the test-tubes into quart flasks three-fourths full of sterilized must; from the flasks into 10-gallon kegs three-fourths full of sterilized must; and finally into 50-gallon barrels three-fourths full of sterilized must. The transfer from the smaller to the larger vessel was made only when the fermentation was in full swing. In making these transfers, the greatest care was taken to guard against contamination, the casks, bungs, bungholes, etc., being sterilized with steam. When the must in the barrel was at its highest fermenting activity, it was dumped into one of the regular fermenting tanks containing freshly-crushed grapes.

For each fermenting tank to which cultivated yeast had been added, we filled another tank with the same variety of must and the same percentage of sugar, but fermenting by its own natural yeast, to serve as a check. The fermentation of both tanks was recorded and an account kept of the amount of sugar lost each day, the height of the temperature developed, etc. Some of these records are embodied in this bulletin along with the analyses of the wines fermented with both natural and cultivated yeasts, showing gain (or loss) of the wines fermented with cultivated yeasts over those fermented with the natural as regards percentages of alcohol, volatile acid, and unfermented sugar obtained. As there were some three hundred records taken, it would be impossible to discuss them all, so only the most typical are given.

DISCUSSION OF CHARTS.

Fig. 2 shows an ideal fermentation; represented as the diagonal of a rectangle. The figures on one side of the diagonal represent the temperatures, and on the other the percentages of sugar in the must. In this diagram the time that has elapsed between the filling of the tank with must and the completion of the fermentation is four days.

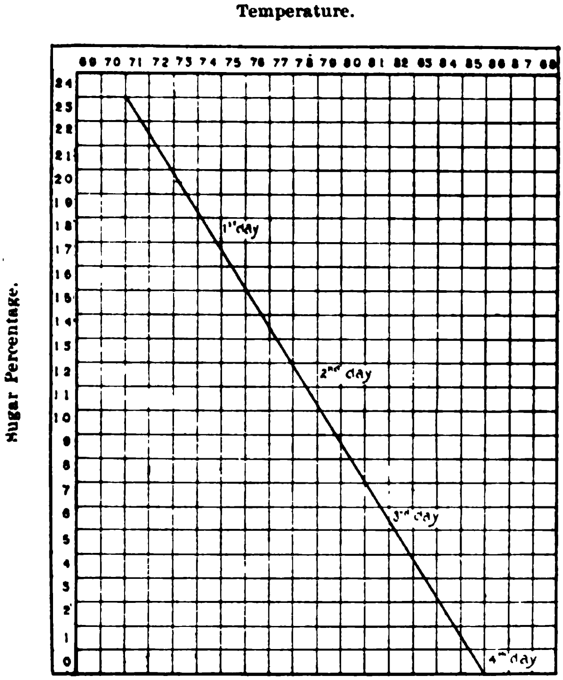

Fig. 2. Diagram showing ideal fermentation.

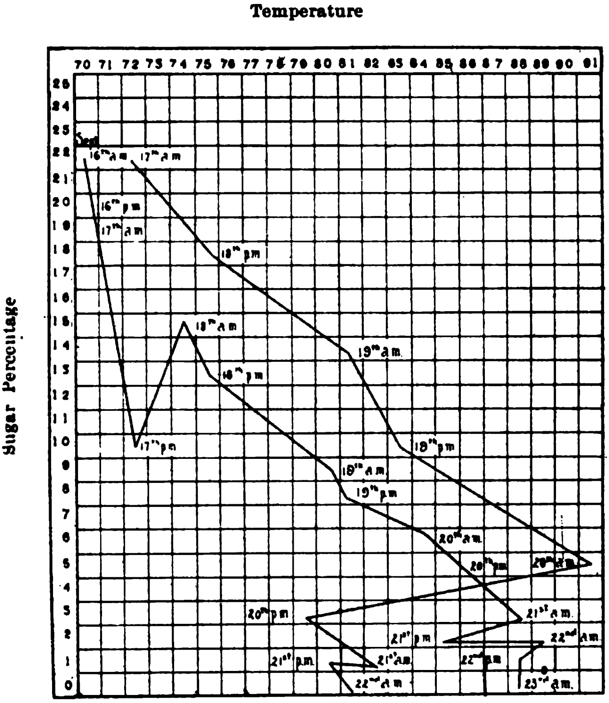

FIG. 3. Typical Zinfandel fermentations, showing great irregularity.

The curves in Fig. 3 show typical Zinfandel fermentations. It can be seen that the fermentation of this variety of grape is very irregular, especially at the end, as previously mentioned (see p. 8). Note that on the 17th of September, P. M., the percentage of sugar in the must was only 10, and on the 18th A. M., the next morning, it had again risen to 15 per cent. This is not an uncommon occurrence, for it occasionally happens that there are dried grapes (raisins) among the bunches that are delivered, and when the fermentation slows, the sugar in the raisins has time to dissolve. This condition is a serious obstacle to the wine-maker, especially when the percentage of raisins is large, as was the case in the vintages 1900 and 1901. The same condition is represented on Fig. 4.

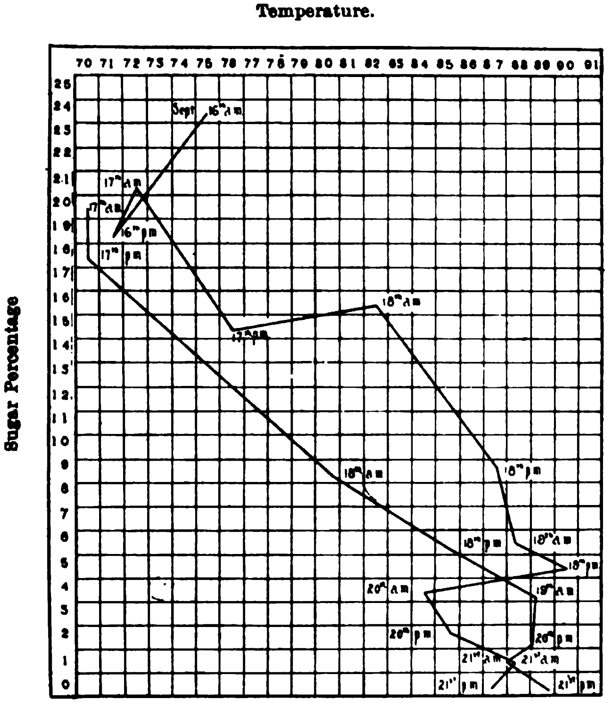

Fig. 4. The irregular line starting September 16th shows typical irregular Zinfandel fermentation.
The straighter line starting September 17th shows that of second crop.

In Fig. 4 the irregular line starting September 16th shows a typical first-crop Zinfandel fermentation; the straighter line that of a second-crop. Note the great improvement in fermentation in the latter, the line showing the reduction of the sugar being nearly straight while 14 per cent is being fermented out. This improvement is due largely to the natural higher acidity of second-crop grapes (see p. 25).

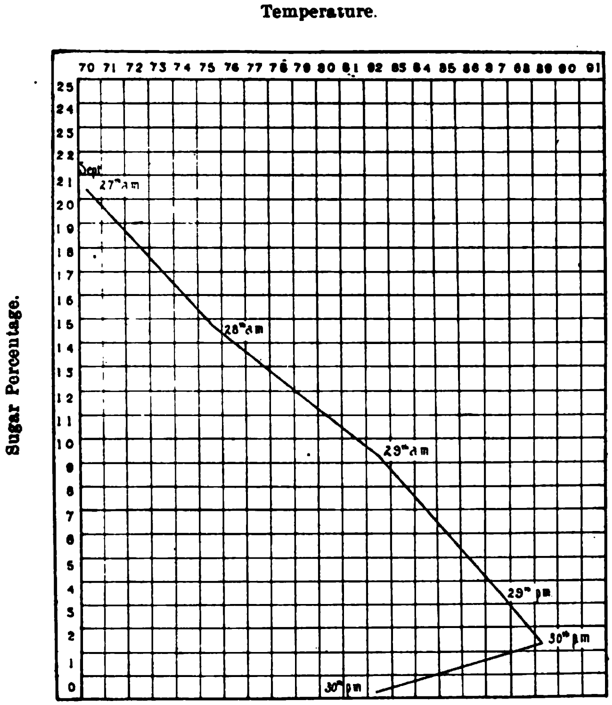

FIG. 5. Zinfandel and Carignane fermentation.

Fig. 5 shows how the fermentation of Zinfandel grapes is improved by mixing a certain proportion of grapes of a variety known to ferment well (Carignane, in this instance).

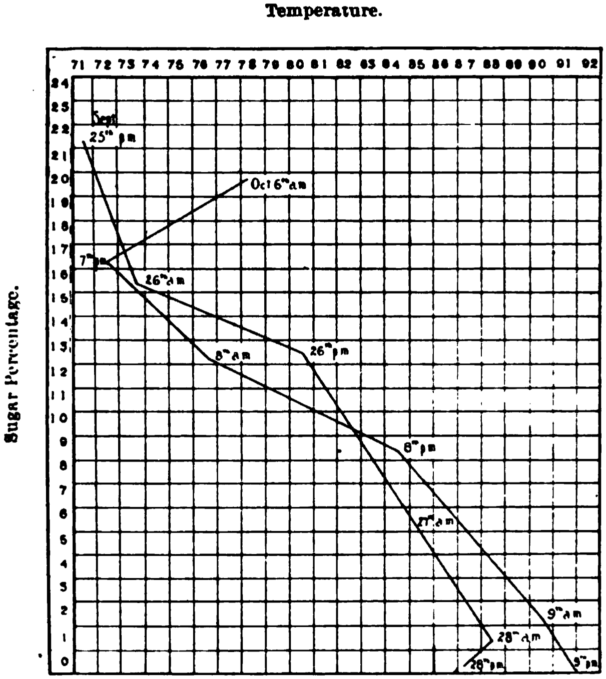

Fig. 6. Typical Carignane fermentations.

The good fermenting quality of the Carignane is shown in Fig. 6, the fermentation being through in three days without very great increase in temperature in one instance, and in three and one half days in the other. Note the regularity in loss of sugar.

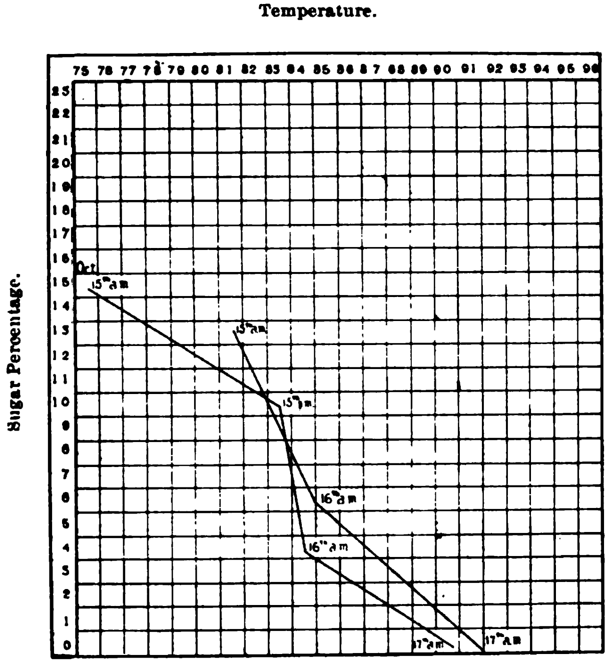

FIG. 7. Typical Burger fermentations.

Typical Burger* fermentations are shown in Fig. 7. Burger is invariably very regular. The must of this variety seldom has over 22 per cent in sugar, while the acidity remains high (.5 to .9). Such a composition is very favorable to a good fermentation (see p. 25). Burger yeast, however, has a good deal to do with the above regularity, as will be shown later by some experiments that are being conducted at present.

---

*It must be remembered that the grape called Burger in California is not the true Burger of the northern grape belt of Europe. Its true origin has not been definitely determined. (See Viticultural Report for 1896, p. 244.)

The following examples show the comparative fermentation of Zinfandel with its own yeast and Zinfandel with cultivated yeast, the must in both tanks being identical. Out of the nine examples given, seven show a gain in favor of the tank fermented with pure cultivated yeast as a starter. The other two are equal to the natural fermentation. The natural yeast is represented by a solid line; the cultivated yeast by a dotted line.

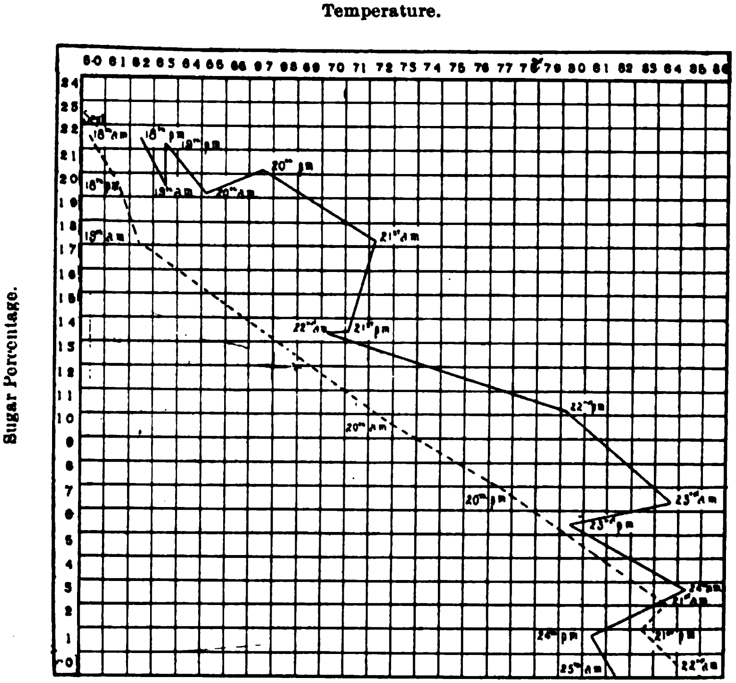

FIG. 8. Natural Zinfandel fermentation (solid line) and fermentation with pure yeast (dotted line).

	Natural Fermentation.	With Pure Yeast.
Sugar fermented 1st day	0%	4%
" " 2d "	1	7
" " 3d "	7	7
" " 4th "	3	4
" " 5th "	5	..
" " 6th "	5	..
" " 6½ "	1	..
Completed in	6½ days	4 days

In the fermentation shown in Fig. 8 the tank with cultivated yeast was dry two and a half days before the tank fermenting on its natural yeast, the regularity of fermentation being nearly perfect in the tank with cultivated yeast.

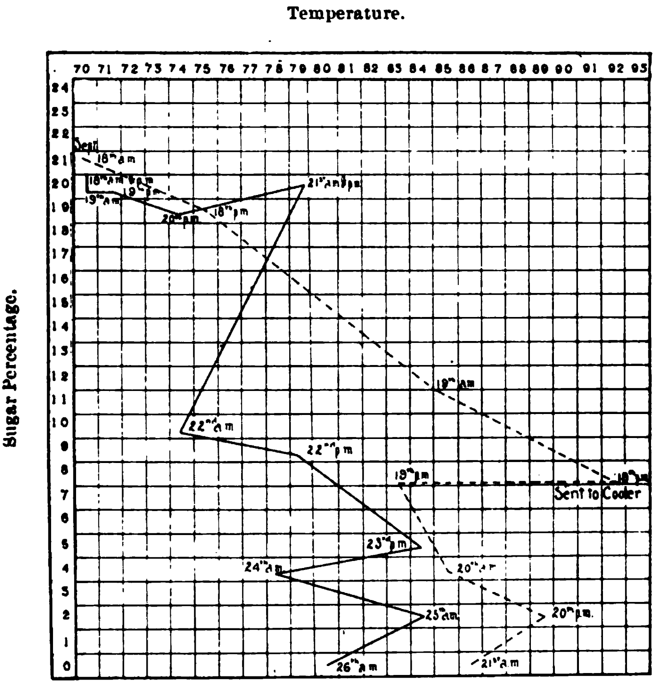

Fig. 9. Natural Zinfandel fermentation (solid line); the same with pure yeast (dotted line).

	Natural Fermentation.	With Pure Yeast.
Sugar fermented 1st day	1%	2%
" " 2d "	1	11
" " 3d "	1	6
" " 4th "	1	4
" " 5th "	10	--
" " 6th "	1	--
" " 7th "	4	--
" " 8th, 9th "	4	-
Completed in	9 days	4 days

This chart (Fig. 9) also shows a gain of five days in favor of the tank with cultivated yeast, the regularity of fermentation being also in its favor. The apparent irregularity in the dotted line representing the pure cultivated yeast fermentation on the 19th P. M. was due to the must in the tank being sent through the cooler.

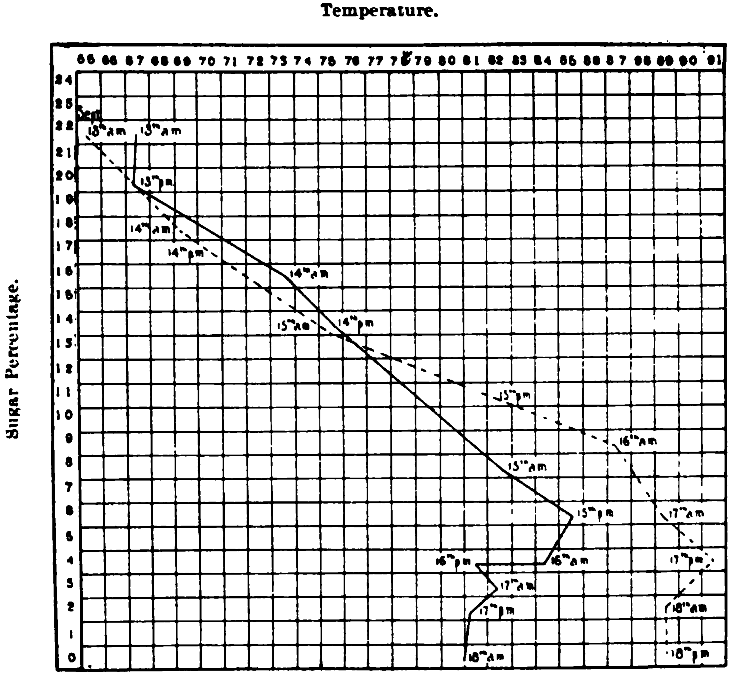

FIG. 10. Natural fermentation of Zinfandel (solid line), and with pure yeast (dotted line).

	Natural Fermentation.	With Pure Yeast.
Sugar fermented 1st day	6%	3%
" " 2d "	8	5
" " 3d "	4	5
" " 4th "	1	3
" " 5th "	3	4
" " 6th "	--	2
Completed in	5 days	5½ days

In this instance (Fig. 10), the natural fermentation was more rapid, being a half day in advance of the tank with the cultivated yeast; but the natural fermentation is quite irregular toward the end.

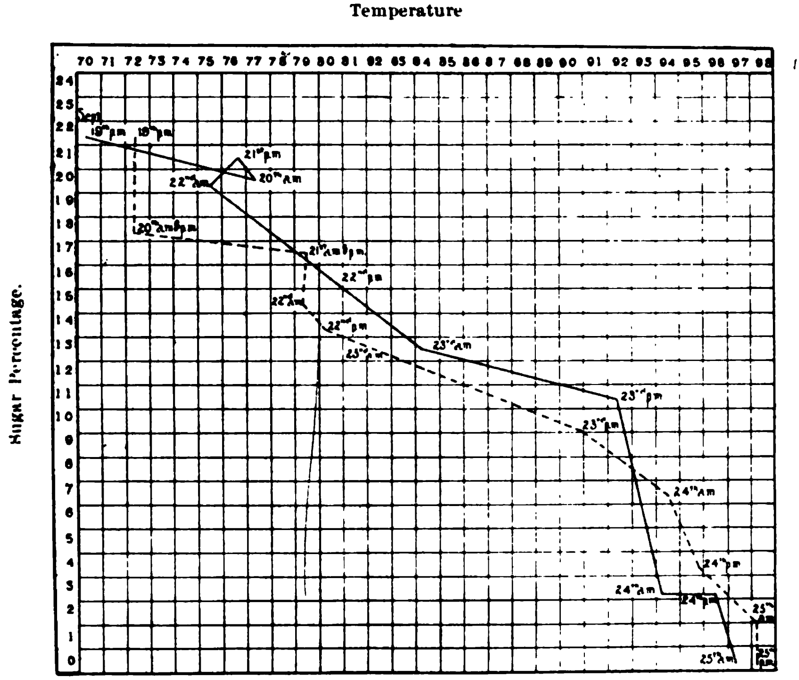

Fig. 11. Natural fermentation of Zinfandel and Carignane, mixed (solid line); the same fermented with pure yeast (dotted line).

	Natural Fermentation.	With Pure Yeast.
Sugar fermented 1st day	2%	4%
" " 2d "	1	1
" " 3d "	5	3
" " 4th "	5	4
" " 5th "	8	6
" " 5½ "	3	--
" " 6th "	--	4
Completed in	5½ days	6 days

The result shown in Fig. 11 does not bring out much difference between the two fermentations. The tank with the cultivated yeast is half a day behind, but more regular in the reduction of the sugar toward the end. Notice that in this case there is a mixture of Zinfandel and Carignane.

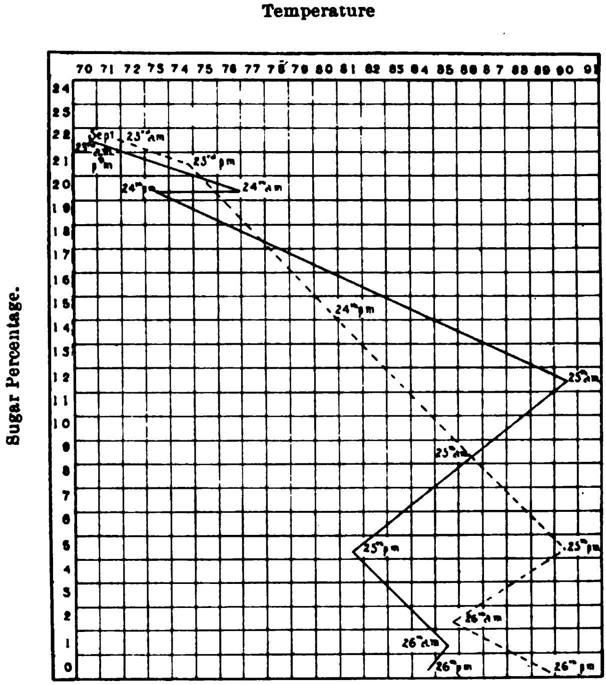

FIG. 12. Natural fermentation Zinfandel and Carignane, mixed (solid line); with pure yeast (dotted line).

	Natural Fermentation.	With Pure Yeast.
Sugar fermented 1st day	2%	5%
" " 2d "	8	7
" " 3d "	11	8
" " 3½ "	2	2
Completed in	3½ days	3½ days

Here, as shown in Fig. 12, there is also a mixture of Zinfandel and Carignane, and the fermentation lasts three and one half days in both tanks; but the tank with the cultivated yeast is far more regular.

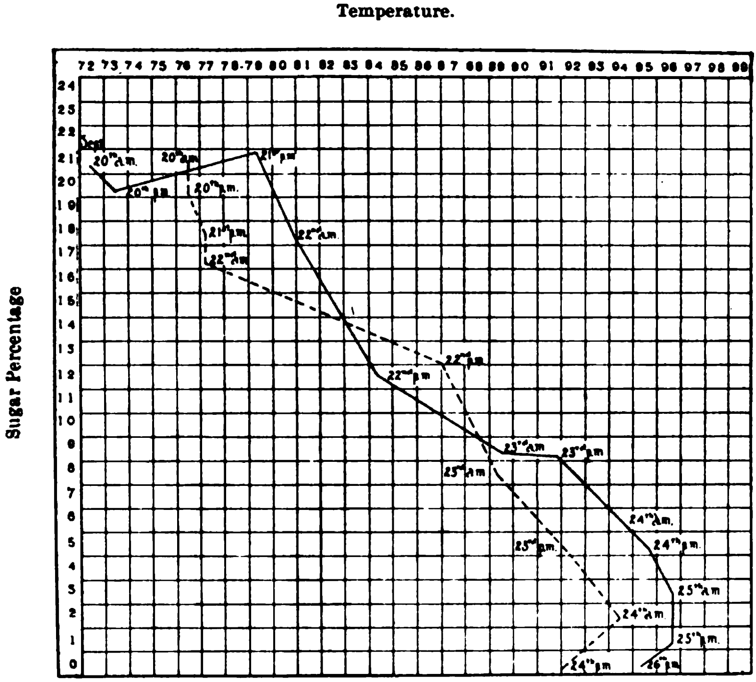

FIG. 13. The solid line shows natural fermentation of Zinfandel and Carignane; the dotted line shows same fermented with pure yeast.

	Natural Fermentation.	With Pure Yeast.
Sugar fermented 1st day	0%	2%
" " 2d "	9	2
" " 3d "	3	9
" " 4th "	4	6
" " 4½ "	--	2
" " 5th "	4	--
" " 6th "	1	--
Completed in	6 days	4½ days

In this fermentation of Zinfandel and Carignane, mixed (Fig. 13), the pure yeast has gained half a day on the natural yeast and is also more regular.

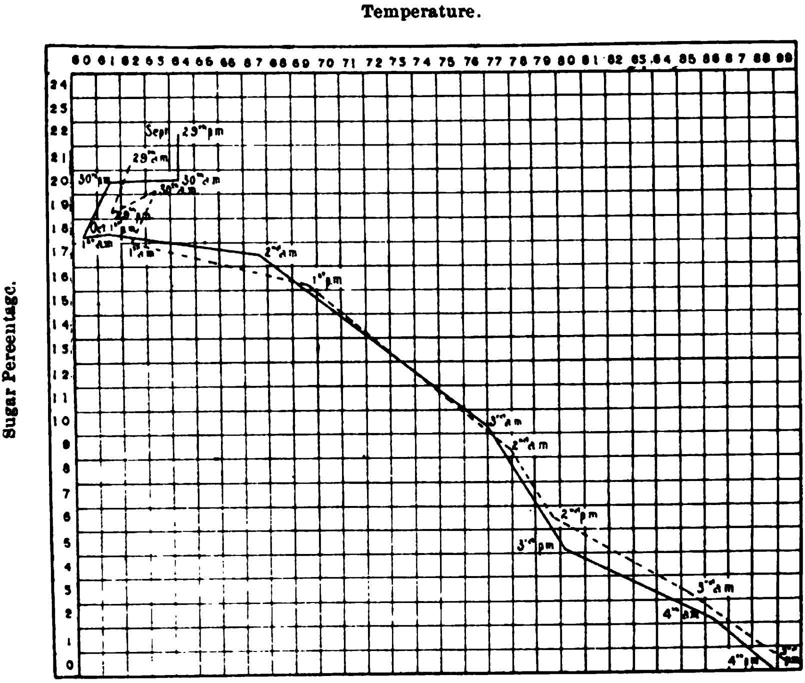

Fig. 14. Natural fermentation of Carignane and Malvoisie, mixed (solid line); with pure yeast (dotted line).

	Natural Fermentation.	With Pure Yeast.
Sugar fermented 1st day	2%	1%
" " 2d "	2	2
" " 3d "	4	9
" " 4th "	7	6
" " 5th "	5	3
Completed in	5 days	5 days

The fermentation of a mixture of Carignane and Malvoisie is shown in Fig. 14. The good fermenting quality of the Carignane shows in the regularity of the fermentation under natural conditions. There is, however, a slight gain of half a day in favor of the cultivated yeast.

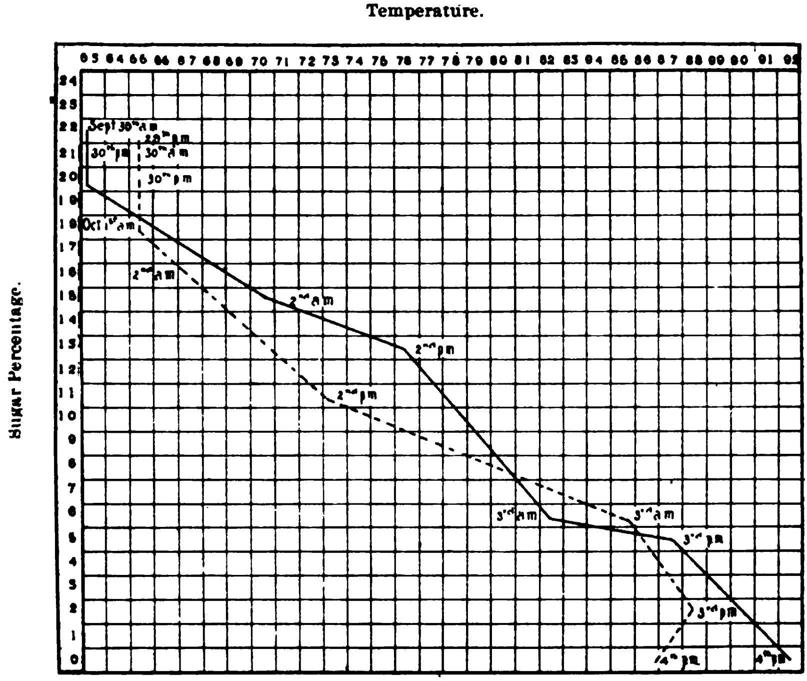

Fig. 15. Natural fermentation of Carignane and Malvoisie, mixed (solid line): the same fermented with pure yeast (dotted line).

	Natural Fermentation.	With Pure Yeast.
Sugar fermented 1st day	2%	3%
" " 2d "	1	3
" " 3d "	6	6
" " 4th "	8	8
" " 4½ "	5	--
" " 5th "	--	2
Completed in	4½ days	5½ days

The results in these two tanks of Carignane and Malvoisie, mixed (Fig. 15), were identical, both fermentations finishing at the same time.

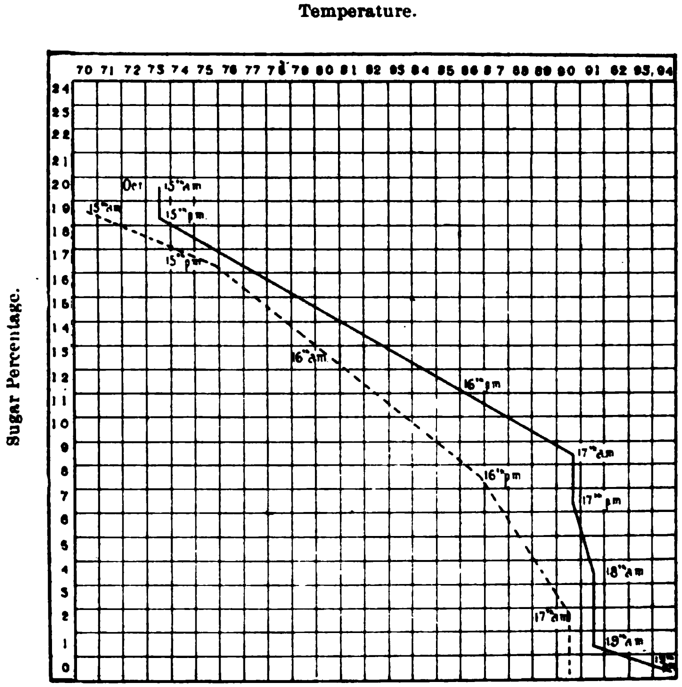

Fig. 16. Natural fermentation of Mataro and Carignane, mixed (solid line); same fermented with pure yeast (dotted line).

	Natural Fermentation.	With Pure Yeast.
Sugar fermented 1st day	1%	3%
" " 2d "	3	6
" " 3d "	7	11
" " 4th "	5	2
" " 4½ "	4	--
Completed in	4½ days	3 days

With two varieties, such as Mataro and Carignane, that ferment well (Fig. 16), we have a regular and rapid fermentation, but the tank with the cultivated yeast is much more regular and one and one half days ahead.

Analyses of Wines resulting from Various Fermentations Recorded on Charts.—From an observation of the analyses of the wines resulting from the fermentations recorded on Figs. 8, 9, 10, 11, 12, and 13, it will be seen that the percentage of alcohol in the wines fermented with cultivated yeast is either greater than or about the same (with the exception of No. 13) as in the wines fermented on their natural yeasts. The volatile acid and the percentage of unfermented sugar are in all cases lower in the wines fermented on cultivated yeast.

Analyses of Wines resulting from Fermentation with or without Addition of Cultivated Yeast.

Corresponding to Charts.

Chart No.	Tank No.	Fermentation.	Alcohol. Per Cent by Volume.	Volatile Acid. Grs. per 100 c.c.	Reducing Sugar. Grs. per 100 c.c.
8	314	Natural	12.0	.084	.265
	294	Yeast No. 6	12.3	.065	.090
9	292	Natural	10.9	.133	.110
	291	Yeast No. 6	10.9	.052	.075
10	173	Natural	11.9	.096	.205
	272	Yeast No. 5	11.8	.080	.100
11	307	Natural	12.3	.094	.170
	177	Yeast No. 5	11.8	.080	.120
12	307	Natural	12.3	.094	.170
	313	Yeast No. 5	12.3	.085	.110
13	172	Natural	11.9	.096	.205
	171	Yeast No. 6	12.4	.093	.175

Correction of the Acidity of the Must.—It has frequently been stated that when the must is deficient in free acid, the fermentation is slower, and sometimes the wine does not pull through. Roos and Chabert, Bouffard, Casalis, and Coste-Floret in France are among the authorities who have demonstrated the importance of correcting the acidity of the vintage. It appears that 0.7 to 0.8 per cent is about the normal amount of acidity needed in the fermentation of dry red wine. When the acidity falls below, it is a common practice in Italy and France to raise the acid strength to this standard by adding tartaric acid to the crushed grapes. This is considered a lawful operation, for if the addition be properly made, it does not add anything to the wine that would be injurious to health, nor does it increase the volume; most of the acid is precipitated with the lees.

During the vintage we made numerous investigations on the effect of various percentages of acidity on the fermentation of must, and clearly demonstrated that when the acidity was deficient, the fermentation suffered. In such cases we increased the acidity to the European standard, with good results. Different varieties of grapes need different acidities, but probably 0.65 to 0.75 per cent for white grapes and 0.70 to 0.80

per cent for reds is sufficient for California wine. We expect to continue this investigation, with experimental data, this coming vintage. (See Figs. 4 and 7.)

The Addition of Sulfurous Acid or Sulfites to White Wine.—We made some investigations on the principle of Andrieu for the handling of white grapes. His theory is to stop the natural fermentation of the must by adding sulfurous acid (sulfur fumes or a metallic sulfite). The fermentation being checked for a period of from twenty-four to forty-eight hours, the dirt settles and a comparatively clean must can be drawn off. The clean must is then inoculated with a pure cultivated yeast trained to ferment in the presence of as great or a greater percentage of sulfurous acid than has been added to the must. The advantage of this method is supposed to be the improvement of the wine, as it is fermented in a comparatively clean state. Very satisfactory results have been obtained by this method in the treatment of grapes that have been damaged by mildew or early rains.

We have not sufficient data to offer any conclusions this year, but the method seems very promising. Further investigations will be made the coming vintage.

Points Noted on Comparison of Fermentations with and without Cultivated Yeasts.—1. Fermentation with cultivated yeasts is more regular.

2. Start of fermentation with cultivated yeasts is more rapid.

3. Period of fermentation is about the same in both.

4. Temperature is the same.

5. The correction of the acidity in the must to 0.7 or 0.8 per cent with tartaric acid greatly assists the fermentation of dry wines.

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MANUFACTURE OF DRY WINES IN HOT COUNTRIES.

By FREDERIC T. BIOLETTI.

BULLETIN No. 167.

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MANUFACTURE OF DRY WINES IN HOT COUNTRIES.

By FREDERIC T. BIOLETTI.

[This bulletin is the outcome of a recent visit, made under the auspices of the University, to some of the chief vine-growing regions of Europe and Algeria.

This visit was undertaken during the months of October, November, and December, 1904, and its main object was to study the many changes which have been introduced in recent years into French methods of grape-growing and wine-making. As it was impossible, in the time available, to cover the whole of the ground thoroughly, my attention was directed mainly to those subjects which seemed of most immediate interest to the University and to the committee of California grape-growers who contributed part of the necessary expenses of the trip.

In accordance with this idea, my observations had to do chiefly with the methods of wine-making peculiarly adapted to hot climates, and with the methods of viticultural and œnological education in vogue in France. Other matters of interest to Californian viticulture were given as much attention as was possible without interfering with these two main objects.

The principal educational institutions visited were the "Kgl. Lehranstalt für Wein, Obst und Gartenbau" at Geisenheim on the Rhine, the "Institut Nationale Agronomique" at Paris, the "École Nationale de Grignon" near Versailles, the "École Nationale de Montpellier" in the south of France, and the "École Pratique d'Agriculture d'Écully" near Lyons. At all of these, especial attention is given to instruction in viticulture and œnology.

Experiment stations and research laboratories devoted more or less exclusively to the same subjects were visited at Nancy, Epernay, Villefranche, Nimes, Montpellier, Narbonne, Perpignan, Toulouse, Bordeaux, and Algiers. Visits were made to the departmental professors of agriculture at these centers and to vineyards and cellars in the Rheingau, Champagne, Burgundy, Beaujolais, Côtes du Rhone, Hérault, Gard, Narbonnais, Roussillon, Médoc, and Algeria; the greater part of the time being spent in the Midi and in Algeria. My investigation was very much facilitated by the great courtesy and assistance received everywhere from investigators and proprietors. My thanks are especially due, among many others to: Professor Dr. Wortmann, Director of Geisenheim; M. Pierre Viala, Inspecteur Général de la Viticulture at Paris; M. L. Ravaz, Professor of Viticulture at Montpellier; and M. Roger Marès, Departmental Professor of Agriculture at Algiers.

I was much assisted in my investigations by the advice and encouragement of members of the California Viticultural Club, notably of Messrs. Percy L. Morgan and Frank T. Swett, without whose aid the scope of the work would have been very limited.]

INTRODUCTION.

It is a remarkable but well-recognized fact that in the regions where the vine flourishes best, that is, where it yields the maximum crop for the minimum labor, the greatest difficulties are encountered in the manufacture of sound dry wines. In a general way it may be said that nearly all the fine dry wines of the world are produced in regions such as those of the Gironde, Burgundy, and the Rhine, where the climate is relatively cool and where the vine does not attain its fullest development either of growth or of crop. In the warmer and more productive regions, if wines of superior quality are made they are usually sweet or of sherry type. The *dry* wines of these regions are of two general types, (*a*) thin watery wines, such as those of the south of France, whose main value lies in their cheapness, and (*b*) heavy, coarse wines valuable for blending, such as those imported into France in large quantities from Spain, Algeria, and elsewhere. The wines of the latter type are not only defective in quality, but very commonly unsound, and large quantities, in the aggregate, spoil before they reach the hands of the wine merchant and become a total loss or are made into inferior brandy. This loss would be much greater but for the use of the antiseptics which are freely employed wherever the practice is not prevented by effective pure-food laws. Before discussing the question as to whether the wines of the warmer regions can be improved, and, if so, what are the most practical methods, a clear understanding of the nature of their defects and the causes of these defects is necessary.

The quality of a wine depends on two groups of factors: (*a*) those which have to do with the nature of the raw material, that is, the character of the grapes; and (*b*) those which have to do with the way in which this raw material is treated, that is, the character of the methods of manufacture. Each of these groups of factors influences the other, so that it is often difficult to decide whether certain qualities of a wine are due to the character of the grapes, or to the way in which they have been handled in the process of manufacture. For example, a wine is deficient in color: this may be due either to a lack of coloring matter in the grape or to an imperfect method of manufacture which has failed to properly utilize the coloring matter present. Again, if a wine is spoiled by bacterial fermentation, the cause may lie in careless, uncleanly methods of manufacture, or in a lack of due acidity in the grapes, which favored the growth of bacteria. In this way nearly all the qualities of a wine are influenced, both by the character of the raw material and by the method of manufacture; and a defect in either may often be neutralized to a great extent by a corresponding change in the other.

The relative importance of these groups of factors is a matter on which the opinion of wine-makers has been greatly modified during the last ten or fifteen years. Formerly, the first group was considered of overwhelming importance and certain regions were considered totally unfit for the production of sound dry wine, on account of the supposed unsuitable nature of the grapes grown there. Yet many of these regions produced the finest, largest, and best flavored table and raisin grapes. Now, while the qualities desirable in an eating grape are not the same as those necessary for a wine-making grape, there is no doubt that the main reason for the failure to produce good dry wines in the plains of

Algeria or the San Joaquin Valley does not lie in the qualities, either negative or positive, of the grapes, but *in the attempt to make wines in a hot climate by methods suited only to a cool one.*

It is worthy of note that in the regions that have been famous for the production of fine wines, such as Médoc, Rheingau, and Burgundy, the finest and highest-priced wines are produced on warm, dry hill slopes, and in years when the summer is exceptionally warm and dry. This is equivalent to saying that the finest wines of these regions are produced in situations where the soil conditions approach most nearly to those of California vineyards, and in seasons when the weather during the growing and ripening period of the grape approaches most nearly to the California climate. In fact, the more nearly the chemical composition of the grapes of the Rhine and the Gironde approaches that of California grapes, the higher the quality of the wine and the higher the price it brings in the market. Yet it is perfectly true that it is only exceptional and apparently accidental when our California wines equal or approach the quality of the best wines of the above regions.

If the composition of the raw material is approximately the same, the quality of the manufactured material ought not to differ much unless the conditions of manufacture are different. It is doubtless in the failure to make these conditions identical or equivalent that the chief difficulty lies. The use of the same methods does not result in realizing the same conditions in a hot climate as in a cool one, and whatever the summer temperature of the Gironde may be, the temperature of the autumn, when wine-making takes place, is always very much cooler than it is here. Many of the defects of our wines which were supposed to be due to inherent faults of the grapes have been shown to be due to bacterial and defective yeast fermentation, and to be completely under the control of a suitable method of wine-making. This does not mean that the locality where the grapes are grown is without influence, or that it will ever be possible to produce a Château Lafitte or a Schloss Johannisberg in Hérault or Tulare. It does mean, however, that wherever grapes mature a perfectly sound wine of good quality can be made, and that *throughout the great central plain of California sound dry wines can be produced in unlimited quantities, superior in quality to the great bulk of European wines.*

The average sugar-contents of the grapes of the plains of southern France will probably not exceed 16%, while that of the grapes of the San Joaquin will be approximately 20%. There is a corresponding superiority in other ingredients such as body and tannin; in everything, in fact, except acidity and perhaps color. The first of these defects can be remedied legitimately and without any great expense artificially, while the second can be minimized by proper methods of wine-making and by a suitable choice of varieties. Taking these facts into consideration, then, 16 tons of grapes in the San Joaquin Valley are about the equivalent for wine-making purposes of 20 tons in the plains of the Midi. The importance of this is proved by the many attempts being made to increase the alcoholicity of the wines of southern France,* and by the fact that the most effective method at present seems to be a partial concentration of the grapes, by which 20% or 30% of the water is evaporated before they are made into wine. This is equivalent to a reduction in volume of 20 tons to 16 or 14 tons. By this means, from 20 tons of grapes is made about 2,400 gallons of full-bodied wine, suitable for export or blending, having say 12% of alcohol, instead of 3,200 gallons of thin, weak "vin ordinaire," with only 9% of alcohol. With a corresponding 20 tons of Fresno grapes it should be possible to make, without the expense of concentration, 3,200 gallons of wine equal in quality to the 2,400 made from the same quantity of French grapes. That this has not been done, or done only exceptionally and accidentally, is, I believe, *not the fault of the grapes, but of the methods of manufacture.* Much of the dry wine which it is attempted to make in the hot interior valleys of California spoils before it ever reaches the consumer, or more usually is distilled or metamorphosed into an inferior sweet wine. The dry wine at present made in this region is to a great extent of very inferior quality, deficient in normal acidity, tannin, color, aroma, and showing various defects, cloudiness, acetic and butyric acid, mannite, etc., due to bacterial or other improper fermentations. This state of things is so well recognized that most wine-makers of the San Joaquin Valley have ceased to attempt to make dry wine and turn all their grapes into the sweet wines for which the region is so specially adapted.

The crisis to which the sweet-wine market is subject in years of heavy production would be modified if it were possible to turn a certain part of the grape crop into dry wine. Many of the varieties of grapes planted in the great valleys are moreover more suited to the production of dry wines than of sweet. If the making of dry wine is to pay, however, the results must be more under the wine-maker's control and the quality must be higher than it has been in the past.

With regard to the certainty of control it is my firm belief that *there is no region in the world where the wine-maker can be so sure of making every year a good, sound, dry wine of uniform quality as in the great central plain of California.* An opinion so opposed to the practical results of the past was not arrived at without careful consideration, and is based principally upon the methods and tendencies of modern wine-making in Algeria and southern France and on the long and careful tests conducted for many years by the Agricultural Experiment Station of the University of California at the Fresno, Tulare, Amador, and San Luis Obispo substations and the viticultural cellar and laboratories at Berkeley. To attain this desired result, however, requires very considerable changes in the present methods of wine-making, and in the course of this report an attempt will be made to show the essential features of this necessary change.

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* "What we need to satisfy our markets is alcoholic, heavy-bodied, deeply colored wines such as are not produced by our modern methods of intensive cultivation." "La Concentration des Vins," by L. Roos, Bordeaux, 1902.

The conditions upon which the quality of wine depend are:

First—Those which affect the nature of the raw material, viz.: variety of grape, climate, soil, methods of cultivation (including pruning, fertilizing, etc.), vine diseases, time of gathering.

Second—Those which depend on the methods of manufacture. These methods may affect the wine in a great variety of ways. They may modify its composition by means of the addition of various substances which occur naturally in the grape, such as sugar, water, tartaric acid, and tannin, or even of substances which do not occur there in appreciable quantities naturally, such as citric acid and plaster. They may cause a more or less perfect utilization of the substances in the grape, and in this way control to a great extent the amount of color and tannin, and even of alcohol and acid in the resulting wine.

It is in the control of the fermentation, however, that the methods of manufacture have the most scope for affecting the quality of the wine for good or ill. The character of the fermentation depends on four main factors: (*a*) the composition of the grape; (*b*) the kind and number of micro-organisms (yeasts, molds, and bacteria) present; (*c*) the temperature of the fermenting mass; and (*d*) the amount of aëration.

In accordance with these facts, the attempts at finding a solution to the problem of the manufacture of sound, dry wine of good quality in hot climates have been made along different lines, which are discussed in the remaining portion of this bulletin.

METHODS FOR IMPROVING MANUFACTURE OF DRY WINES IN HOT CLIMATES.

A. *Amelioration of the character of the raw material.*
  1. Suitable varieties of grapes.
  2. Appropriate methods of cultivation.
  3. Time of gathering grapes.
  4. More complete utilization of the substances in the grapes.
  5. Addition of substances deficient in the grapes.
  6. Addition of substances not found normally in the grapes.

B. *Control of fermentation.*
  (I) By modifying the temperature.
    1. Cooling devices (physical).
    2. Cooling devices (chemical).
    3. Postponement of fermentation until winter.
    4. Fermentation in a cool locality.
      (*a*) Transportation of grapes.
      (*b*) Transportation of crushed grapes or must.
      (*c*) Concentration of grapes for transportation.
      (*d*) Drying grapes for transportation.
  (II) By controlling the kind of fermentative agents present.
    1. Sterilization (physical).
    2. Sterilization (chemical).
    3. Pure and selected yeasts.

AMELIORATION OF THE CHARACTER OF THE RAW MATERIAL.

VARIETIES OF GRAPES.

The proper choice of varieties of grapes to plant is the first essential in the production of good dry wine in any climate, and is especially necessary in one which is either cooler or hotter than the normal for the growth of the vine. A variety which gives excellent results in one climate is often quite useless in another. The grapes of Roussillon will not ripen on the Rhine, and those of Burgundy will not bear paying crops in Fresno. The Cabernet Sauvignon, the grape from which the bulk of the Château wines of the Médoc is made, the highest-priced red wines made anywhere, is said to produce an undrinkable wine in Algeria.

For this reason nothing very certain can be gathered regarding varieties suitable for our hotter regions by noting which are planted in other countries. Luckily, the long and complete series of variety tests which the Agricultural College at Berkeley has made during the last twenty years has solved this question very satisfactorily for most parts of California, especially as to what varieties are most suitable for red wine. A short summary of these results was published in the Report of the College of Agriculture in 1898,* and it is interesting to see how far they correspond with the experience and practice of southern French and more particularly of Algerian growers.

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* Partial report of Work of the Agricultural Experiment Station of the University of California. Art., "Memoranda on Wine, Table, and Raisin Grapes," pp. 245-253.

In the south of France very few varieties are planted on a large scale, and the great bulk of the vineyards consists of Aramon. This is the ideal grape for quantity, producing an abundance of thin watery wine with good acidity and, though deficient in alcohol, color, body, and flavor, without any positive defects and capable of improvement by blending with suitable heavy wines such as those from parts of Algeria. During the last few years of heavy production and increasing competition with "sugar wines" and with similar but superior wines from the rich plains of Algeria, the Aramon has been much less profitable, and there is a tendency now to plant grapes yielding a less watery product. The principal of these are the Grand Noir (a kind of Bouschet), the Petit Bouschet, and the Carignane. The last would be planted more but for its susceptibility to fungous diseases. In higher and well-drained land the Alicante Bouschet, which is recognized as the best of the Bouschets, is planted, but on lower and richer soil it is found extremely difficult to defend it from oidium and other fungous parasites. A few Matarò, Mourastel, and Cinsaut are found, but not in large quantities. For white wine the Aramon is used principally, together with the Piquepoule and the Terret.

In Algeria at the present time hardly anything is planted except the Carignane and Alicante Bouschet, which unite there, better than any other varieties, productiveness with fair quality. Their susceptibility to disease is more easily controlled in the drier climate of Algeria, but they still require a certain amount of spraying. Other varieties grown there, to some extent, are Cinsaut, Aramon, Mourastel, and Grenache for red, and Farana for white wine. These, especially the first two, do not give thorough satisfaction, on account of their lack of the color, body, and alcohol which constitute the main value of Algerian wines. In the higher regions, especially in the neighborhood of Miliana, where the best wines of the country are produced, a certain amount of Pinot and Gamai vines are grown; but these are gradually giving way to the Carignane, which produces much more abundantly. Very little seems to have been done in experimenting with varieties other than those of France. The vines of Burgundy and the Médoc have generally failed to give the desired results in either quality or quantity, and the varieties adopted are those among the southern French grapes which suit the conditions best.

In the report of the Agricultural Experiment Station referred to above, the varieties recommended for the production of dry red wine in the hotter parts of the San Joaquin Valley are Alicante Bouschet,* Valdepeñas, St. Macaire, Lagrein, Refosco, Barbera; and for the foothills of the Sierra, Alicante Bouschet, Aramon, and Serine. There seems no occasion at present to modify these recommendations, and it is extremely desirable, if dry red wines are to be made in those regions, that larger quantities of these varieties, especially of the first two, should be planted instead of so much Carignane, Matarò, and Zinfandel, which give much inferior results there, so far as regards quality, without a sufficiently great compensation as regards quantity. For dry white wine, the varieties recommended were Burger, Folle blanche, Aramon, for the valley, and possibly Clairette for the foothills; but it is doubtful if at present it is advisable to plant grapes for dry white wine in those localities. That throughout the valley, dry red wines of quality equal at least to those of the plain of the Metidja in Algeria can be produced there can be little doubt, if a certain proportion of Valdepeñas or any of the other varieties recommended are grown to bring up the color, acid, extract, and aroma of the varieties already planted, and if a system of wine-making is adopted which will utilize the good qualities of the grapes and neutralize the injurious effects of the high temperature of the vintage season.

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* This variety and the Petit Bouschet were distributed over California with exchanged labels, and in this way became interchanged at the Experiment Stations. The remarks in older reports, including the one referred to, regarding "Petit Bouschet," apply therefore to Alicante Bouschet.

TIME OF GATHERING THE GRAPES.

The stage of ripeness at which the grapes are gathered has great influence on the character of the fermentation and the quality of the resulting wine. Within certain limits the less mature the grapes, the more acid and the less sugar will they contain, and the easier and more complete will be the fermentation. For this reason the premature gathering of the crop has been suggested and practiced as a means of avoiding difficult fermentations in hot regions. So far as the avoidance of "stuck" wines is concerned the method is usually successful; but there is loss in both quantity and quality, which in many cases more than counterbalances the gain.

With regard to the *quality* of the wine, it is well known that the best wine can be made only from grapes which have reached the stage of maturity which is known as "wine-making ripeness." Before that stage is reached the grapes not only contain substances which give a disagreeable harshness to the wine, but have failed to elaborate those other substances to which the finer flavors and aromas of good wine are due. To a certain extent, this stage of ripeness is independent of the degrees of sugar or acidity present, and can only approximately be determined by means of the mustimeter and acid test, or other analytical means alone. While an Aramon in the south of France may have attained its optimum degree of maturity for wine-making purposes when it contains 16% of sugar, a Matarò in the Sacramento Valley may be still far from ripe enough for the same purposes when it contains 20% of sugar.

We can not, therefore, gather our grapes prematurely without some sacrifice of quality, and it is only in the absence of better means of controlling the fermentation that it can be recommended. This loss of quality can be minimized in many cases, however, while still retaining the advantages. If instead of gathering all the grapes when they are imperfectly mature, we allow the main part of the crop to reach "wine-making ripeness" and then crush them with a suitable proportion of very unripe grapes to enhance the acidity, we improve the fermentation with less detriment to the quality. The ripe grapes contain those substances necessary for the quality of the wine, and the unripe those necessary for a good fermentation. This can be done only when the ripe and the unripe grapes can be obtained at the same time, for it is essential that they should be crushed and fermented together. The two kinds of grapes may be of different varieties, ripening at different epochs, or of the same variety, from early and late locations or localities. One of the best methods of applying this remedy is to use the bunches of second crop on the same vines. When the first crop has reached its optimum degree of ripeness, the second crop of most varieties is just in the right condition to correct the lack of acidity in the first. This practice is largely employed in parts of Algeria, and also in South Africa, with great success. The resulting wines, while showing a slight "greenness" to the palate, are much superior in quality to those made altogether from grapes gathered prematurely, while fermenting with equal ease and completeness.

With regard to the *loss in quantity* some interesting conclusions may be drawn from some recent French investigations.* These show an average increase of volume in grapes of 2% per day during the two or three weeks preceding maturity, and an increase of .7% per day of the sugar during the same period. The actual figures noted vary within very wide limits with different varieties of grapes and different localities, but the average of all the results will doubtless give us an approximation to the average in practice. If, then, we gather the grapes before they attain the proper degree of maturity, we obtain a smaller quantity of wine of a lower degree of alcohol. This loss may be considered as the cost of the acid in the partially ripe grapes, to which the better fermentation is due. If we compare this cost with that of a sufficient amount of tartaric or citric acid to attain the same result, we will find it much higher. An example will make this clearer. If we have a vineyard where the grapes at maturity contain 22% of sugar and .4% of acidity, we might, by picking them a week before maturity, have sufficient acidity to insure a thorough fermentation. At this time (using the figures given above) the grapes would contain about 16.9% of sugar and .6% of acidity, and the quantity of bunches that at maturity would weigh 2,000 pounds would at this time weigh only 1,780 pounds. The cost, then, of the extra .2% of acidity that we would obtain may be reckoned as follows:

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*Aimé Girard et L. Lindet: "Recherches sur le développement progressif de la grappe de raisin." Paris, 1898.

220 pounds of grapes, at $15	$1 65
90 pounds of sugar, at 3 cents	2 70
Total cost of acidity per ton of grapes	$4 35

Reckoning the price of tartaric acid at 25 cents per pound, the cost of this .2% of acidity would be only $1; and if citric acid were used, the practically equivalent amount would cost even less. These figures are merely approximate, and the difference in cost may often be less than this; but it is just as likely to be more.

If, then, we consider the *losses in both quality and quantity*, it is rarely if ever advisable to pick grapes prematurely for the purpose of promoting a good fermentation; cheaper and better methods are usually available. The principal exception is when a second crop is available in the right condition when the first crop is being picked, especially when this second crop is of a variety which can not be depended on in the locality to attain full ripeness later.

Another point of practical importance regarding the time of gathering is worthy of notice. In large vineyards of one variety of grape or of several ripening at about the same time, it is impossible to gather all the grapes just at the most desirable stage of maturity. For this reason it is usually necessary to commence gathering before the grapes have quite reached this stage, and to continue after they have passed it. In Algeria it is usual to commence the vintage as soon as the grapes are capable of producing wine of 8% of alcohol, and before the vintage is over they are usually sweet enough to produce wine of 12% to 14% of alcohol. If all the fermentations are complete a good average wine is made by blending all together. The high acidity of the early-gathered grapes supplements the low acidity of the late-gathered grapes. Too much acidity in the must is a much less serious defect than too little, as much is deposited during fermentation, and more during the first few weeks following. The cause of this is the presence of alcohol and the fall of temperature, both of which conditions make the wine less capable of holding the acid tartrates in solution. For this reason, when the wine made toward the end of the season is deficient in acid it is desirable to blend it with the early-made acid wine as soon as possible, before the latter has deposited too much of its acidity. Some wine-makers in fact mix the early-fermented wine with the over-ripe grapes when they are crushed or when they have half fermented. This utilizes the surplus acidity most effectually, and at the same time aids fermentation by diluting the sugar and cooling the temperature of the later fermentations. The method has the defect, however, of entailing a double handling of a part of the wine, and exposing a wine which is already made and sound to the risks of a second fermentation under less favorable conditions than the first.

METHODS OF CULTIVATION.

The composition of the grapes, as well as the amount of the crop, can be modified very considerably by the system of pruning, tillage, irrigation, and manuring adopted. The old idea that the smaller the crop the higher the quality of the wine is by no means always or even generally true. Anything which weakens the vine beyond a certain limit will decrease its bearing capacity, and at the same time injure the quality of the grapes. Vines weakened by disease, soil exhaustion, or lack of soil moisture produce badly ripened grapes, deficient in sugar, acid, and other elements which are necessary for the production of good wine. This is especially true of any condition which prevents an abundant growth of healthy leaves throughout the season. When the leaves cease to perform their functions properly, the grapes cease to develop. For this reason it is often possible, by appropriate cultural methods, to increase the quantity of the crop, and at the same time to ameliorate its quality. Anything which increases the size of the bunches and berries without interfering with their normal ripening usually improves their quality. This is particularly true in hot climates, where there is ordinarily no lack of sugar in the grapes or where there is often too much.

On the other hand, anything which increases the number of bunches at the expense of the proper development of the individual berries usually produces a deterioration in the quality; and often the increase in quantity is more apparent than real, as small, badly developed grapes yield comparatively little wine.

Pruning.—The larger and more vigorous a vine, the more grapes it is capable of bringing to perfection. The more buds one leaves on a vine in pruning, the more bunches it is enabled to produce. Our pruning should be so calculated, therefore, as to give the vine the opportunity to produce as many bunches as it can properly support and bring to the desired degree of maturity. A vine pruned too long or given too many spurs may yield a large number of bunches, but the grapes will be deficient in juice, sugar, acid, and all the constituents essential for good wine. Increasing the amount of bearing wood on a vine will increase the crop only within certain limits. To pass these limits we must strengthen the vine by improved tillage, irrigation, and fertilization. An essential condition of both good crops and good wine is a strong healthy vine.

Irrigation.—It was long believed that it was impossible to make good wine from irrigated vineyards. But this is no more true than the equally widespread belief that irrigation is incompatible with the production of other good fruit. Irrigation properly applied is in fact one of the surest means of insuring both the quantity and quality of the crop, as it gives the vine the amount of water it needs at the time it needs it. It frequently occurs during the latter part of dry seasons, especially with late ripening varieties such as Matarò, that the grapes suddenly cease to develop either in size or sugar, in spite of the warm weather. This is because the vegetation of the vine is arrested and the leaves and roots fail to perform their functions properly. Grapes grown on a dry hillside may, under such conditions, fail to develop more than 16% of sugar, while the same variety in a moister soil with the same weather conditions may reach 20%. Under such conditions irrigation, when practicable, will remedy the trouble. Irrigation may also be used to remedy the opposite condition, viz.: the development of too much sugar in the grapes. Many convincing tests of summer irrigation of vines have lately been made in southern France. Those of A. Müntz* are particularly suggestive to Californians, as they were made in the Roussillon, where the climate resembles more nearly that of California than in any other part of France. In a series of twelve tests made with Aramon and Carignane vines, late summer irrigation increased the weight of grapes produced 29%, and the weight of sugar per acre 20%. The average composition of the grapes from irrigated and from non-irrigated vines was as follows:

	Sugar.	Acid.
Irrigated	18.8%	1.11%
Non-irrigated	19.6%	.96%

The wine made from the irrigated grapes contained 11% of alcohol, and that from the others 11.5%, but otherwise the quality was identical. Calculating the value of the crop of wine at 2 francs per degree per hectoliter—the market price at the time of the test, corresponding to 17½ cents per gallon for wine of 11% alcohol—the gain per acre due to the irrigation was $20. There can be no doubt that in many cases the gain in California from irrigation properly applied would be proportionately greater where the grapes tend to produce too much sugar and too little acid for proper fermentation. In many vineyards in the irrigated portions of California undoubtedly as much water as the vines can profitably use is applied, and in some cases more; but no fear need be entertained that irrigation will depreciate the quality of the wine if it does not decrease the sugar-contents of the grapes below 19% (about 20.2%, Balling). There is far more danger that insufficient irrigation in the hot interior valleys will result in grapes deficient in acid and with excessive sugar, giving unsound and inferior wines.

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* "De l'effect des Arrosages Tardifs." A. Müntz, in "Revue de Viticulture," vol. 11, p. 541.

* M. G. Brémond more than doubled his crop by judicious irrigation, at the same time improving the quality and alcoholicity of his wine. "Progrès Agricole et Viticole," vol. 32, p. 697.

The *time of irrigation* is of equal importance with the amount. It is very important that the vine should have sufficient moisture available during the period between what the French grape-growers call the "Véraison"—(the time when the grapes, having attained almost their full size, commence to color)—and full ripeness. During this period there is a migration toward the fruit of materials accumulated in various parts of the vine, and great changes take place in the composition of the grapes. Growth relaxes in the leaves and shoots, which become paler. It is a critical period in the maturing of the crop, and if the vine is not well nourished and supplied with water it is not able to supply the energy necessary for the profound chemical and physical changes taking place in the fruit.* During the latter part of this period, which lasts for from *four* to *six* weeks, it is very important that the vine should not receive a check from lack of available moisture. It is often observed in France and Algeria that when the autumn is hot and dry, the development of the grapes is arrested and the crop is deficient not only in quantity but often in sugar and acid. This explains the good effects of late irrigation, which Müntz in Roussillon (already quoted) and others in southern France have found so noticeable.

Fertilization.—With regard to the effect of fertilization on the quality of the grapes, the same line of reasoning applies as with irrigation. A starved vine will produce not only few grapes but inferior grapes, and a fertilizer which will increase the crop will usually improve its quality; and no deterioration of quality from this source need be feared so long as the sugar-content of the grapes remains sufficiently high. Fertilization of the vines is carried out very thoroughly and regularly in southern France, and the best practice is considered to be an annual treatment. The crop is very much increased by this means, often doubled without sacrifice of quality.†

MORE COMPLETE UTILIZATION OF THE SUBSTANCES IN THE GRAPES.

Some of the defects of the wines of hot countries may be attributed, not so much to deficiencies in the grapes, as to the failure to properly utilize the materials present. The fermentation of red grapes with the stems has been advocated as a means of increasing the body, acidity, and tannin-contents of the wine. In the south of France this is the common practice. The observed good effect is due, however, not to the materials in the stems, but to those in the skins, which the presence of the stems permits to be more thoroughly extracted. The good effects of fermenting with the stems, then, are mainly indirect, and may be obtained by any means which promotes the extraction of matters from the skins, such as stirring, long maceration, etc. On the other hand, the direct effect of the stems is to give a harshness to the wine which is incompatible with the best quality, and the practice is advisable, therefore, only where very common wines are made. In Algeria the stems are usually rejected, and the extraction of color and tannin from the skins is promoted by pumping-over during the last stages of fermentation.

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* G. Foix: "Cours Complet de Viticulture," p. 267.

† Degrully: "Progrès Agricole et Viticole," vol. 32, p. 669.

In Algeria the use of cooling machines to moderate the heat of fermentation, while almost completely successful in its object of enabling the cellarman to be sure of producing a sound dry wine, has brought a very serious trouble in its train. The main value of Algerian wines, the special character which made them desirable to the wine merchants of France, was their heavy body, high astringency, and deep color. These three important qualities have all been modified by the cool fermentations now practiced. Wines which are not allowed to exceed 90° or 93° F. during fermentation, though they are usually sound and dry, and free from those defects and diseases which used to characterize so many Algerian wines, possess much less body, color, and tannin than the wines made by the old method. The gain, therefore, of greater certainty in results and less spoiled wine is to a great extent offset by the loss of much of the character which constituted the value of the old wines when they were successfully made. It is beginning to be realized now that too much emphasis has been placed on the ill effects of high temperature in fermenting red wine, and the good effects of those temperatures lost sight of. Attempts have therefore been made lately to devise a system of wine-making which will combine the good effects of high temperatures in the complete extraction of the grapes, and the good effects of low temperatures in the complete fermentation of the wine and the absence of injurious ferments.

The most notable system of this kind, and the only one in practical use in Algeria, is that of M. Debono, a large wine-maker of Boufarik. The results of the method were kindly shown at the cellar of M. Duroux at Rouiba, where 200,000 gallons of wine were made by this method last year. The wine, as seen in December, 1904, two months after the vintage, was clear, dry and sound, and superior in color, body, and taste to that of any other large cellar tasted in Algeria. The method in brief is as follows:

1. The grapes are crushed and stemmed into amphoras* of 11,000 gallons capacity, with strainers at the bottom.

2. The must is then drawn off. This is done preferably immediately after crushing, but in practice often after fermentation is half over.

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*The amphoras used in Algeria for fermenting and storing wine are vats shaped like huge bottles, and constructed of concrete, masonry or brick, and lined with glass.

3. This must is pumped into amphoras of 12,500 gallons capacity, treated with sulfite to moderate the temperature, and allowed to ferment until all but about 2% of the sugar has disappeared.

4. As soon as the must contains only 2% of sugar it is pumped back on to the pomace in the original amphora.

5. The pomace in this amphora has meanwhile become very hot—44°–45° C. (111°–113° F.).

6. The must is now pumped over the hot pomace repeatedly until it has extracted sufficient color and tannin, and is then pumped back into the 12,500-gallon amphoras, where fermentation is completed. Usually the wine is quite dry by the time it arrives in the larger amphoras the second time.

The time of the operation from the crushing of the grapes until the wine is placed in the final amphoras is usually about four days. The method requires constant vigilance day and night.

The must should not be allowed to become quite dry before being pumped over the pomace, or the wine will be inferior in color and quality. On the other hand, it must not be pumped over with more than 4% of sugar, or there is danger of a hot fermentation and its accompanying effects.

By this method we get the good effects of hot temperature in the pomace vat, where it macerates the skins and so enables the must to extract the color, body, and tannin. At the same time we get the good effects of low temperature in the must vats, where the wine becomes dry and acquires the bouquet characteristic of cool fermentations. The reason we do not get the bacterial fermentations usually accompanying hot fermentations is probably because the great bulk of the wine never becomes hot, and the yeast remains strong and healthy and thoroughly defecates the wine before the bacteria have an opportunity to injure it. In an ordinary hot fermentation the weakening of the yeast has probably more to do with the growth of bacteria than the favorable influence of the high temperature. There is undoubtedly some loss of alcohol in the pomace vats, due to the very high temperature, but this is apparently more than offset by the gain in alcohol in the cool must vats. I was assured that the wines fermented in this way usually showed a higher degree of alcohol than those fermented in the ordinary way.

Effects of High Temperatures.—The effects of various degrees of temperature in the process of wine-making are of two kinds, which should be carefully distinguished. They are: (1) Those which are due directly to the degree of temperature and its immediate action on the must or wine; and (2) those which are due indirectly to the degree of temperature through its modifying influence on the character and kind of the micro-organisms present. It is, to a great extent, to a failure to properly recognize this distinction that so much difference of opinion exists as to the most favorable temperature for fermentation, and as to the advisability of pasteurizing must or wine.

Under the ordinary conditions of wine-making, the second of these groups of effects is by far the more important. That is, the great differences found in wines fermented at different temperatures between the extremes of 20° C. (68° F.) and 40° C. (104° F.) are due principally to the differences caused in the kinds and proportions of the various molds, yeasts, and bacteria present, and to the different physiological activities of these micro-organisms at various temperatures. The *direct* effects of much wider ranges of temperatures than these, if not continued too long, are in fact extremely slight, proportionally, in the case of must and, when evaporation is prevented, of wine. Clear grape-must may be subjected to any temperature between 0° C. and 80° C. (176° F.) for a short time without any very appreciable effect on its appearance, flavor, or chemical composition. The same is true of wine, if at the higher temperatures the heating is done in such a way as not to cause evaporation of the alcohol.

Practically all the ill effects of a hot fermentation, *i. e.*, production of volatile acids and mannite, failure to convert all the sugar into alcohol, disagreeable flavors, persistent cloudiness, etc., are due, not to the heat itself, but to the bacteria, which multiply and flourish at high temperatures, and to the weakened yeast, which at these temperatures becomes abnormal and acts upon the must in a way very different from its normal and healthy action. If, then, we heat a must to 40° C. (104° F.) artificially when there are no bacteria or yeasts present, none of these undesirable results follow. The taste common in wine fermented at high temperature, often described as a cooked taste, is not, therefore, due to the heat directly, but to the action of bacteria, or perhaps to the action of abnormal yeast.* A real cooked taste, that is, the taste of caramelized sugar, may be given to must by heating it too high, and this is in fact done in some processes of wine-making where the must, or part of it, is concentrated by heating in boilers. It has been shown experimentally, however, that must may be heated to 80° C.† (176° F.) or even 90° C. (194° F.) without contracting this cooked taste in the slightest degree. Where this taste is acquired at an apparently lower temperature, it is due to the fact that, owing to the method of heating over a fire or by means of superheated steam pipes, some of the must is heated much higher than 90° C. and imparts a taste to the whole.

Another taste, undesirable in dry wines, often associated‡ with high temperatures, is that of "rancio." This is the taste acquired by wines upon exposure for a long time to the air. The taste is desirable in ports, sherries, and other sweet and liqueur wines, and many processes are used to facilitate and hasten its acquirement. All these processes aim at increasing the oxidation of the wine, either by fuller exposure to the air or by exposure at higher temperatures. This taste was at one time accredited to the action of a fermentative organism, but it is now well known to be due to simple direct oxidation. Must or wine sterilized and kept in sterilized vessels in contact with the air acquires the taste quite as quickly as when unsterilized. The factors which determine the amount of the taste and the rapidity with which it is acquired, are the temperature and the exposure to the air. If we wish to prevent the acquisition of "rancio," therefore, we must avoid undue aëration and high temperatures. That exposure to high temperatures alone continued for a short time will not cause a wine to become "rancio" is proved by the pasteurization of dry wines at 160° F. out of contact with the air. It has also been proved that must may be exposed to the same temperature under the same conditions with equal impunity. Moreover, Professor Barba, of the Œnological Station at Nimes, has shown that must and grapes can be heated to 70° C. (176° F.) in an open vat for a short time without becoming "rancio." At the Experiment Cellar of the Agricultural Department of the University of California it has been shown that grapes can be heated gradually up to 48° C. (118½° F.) for six hours without any special precautions to exclude the air, and acquire no taste of caramel or rancio. In fact, wines made from grapes heated in this way were remarkable for their clean taste, freshness, and bouquet—qualities associated with cool fermentations.

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* This is well shown in the experiments described on page 25.

† See U. C. Bull. 130, page 6.

‡ Barba, in "Annales de la Société des Viticulteurs de France," vol. VI, p. 96.

The following table summarizes the main effects of high temperature in the making of dry wine:

A. Direct effects:—
  (*a*) Beneficial:
    1. Increase of color.
    2. Increase of tannin.
    3. Increase of body.
  (*b*) Injurious:
    1. Oxidation.
    2. Caramelization.
    3. Loss of alcohol.
    4. Loss of bouquet and freshness.
B. Indirect effects:—
  (*a*) Beneficial:
    1. Destruction of injurious ferments (sterilization) in the unfermented must (artificial heating).
  (*b*) Injurious:
    1. Growth of injurious ferments in the fermenting must (hot fermentation).
    2. Abnormal excretions of the yeast.

In order to utilize our raw material to the utmost it is necessary to devise a system of wine-making which will combine the beneficial effects of heat in the extraction of color, tannin, and body with those of cool fermentation in producing bouquet, freshness, and maximum amount of alcohol. This is what is done to a certain imperfect extent by the Debono method. If the spontaneous heating of the pomace which occurs in that method could be replaced by an artificial heating, the method would be more nearly perfect and more under control. The experiments of Rosenstiehl, Kühn, Mathieu, and others in sterilization of musts for the purpose of using pure and selected yeasts have shown that this can be done. Their methods, however, are rendered unnecessarily troublesome and expensive by attempting to effect: (1) complete sterilization, and (2) complete absence of air. The researches of Kayser and Barba show that neither of these objects are necessary for the ordinary purposes of wine-making, and their results have been fully corroborated by tests made at the California Experiment Station at Berkeley.

Extraction of Color and Tannin by Heat.—In 1898 a series of experiments was made at Berkeley to determine to what extent color and tannin could be extracted before fermentation by direct heating of the grapes. A summary of the results is shown in the following table:

TABLE I. *Extraction of Color and Tannin from Fresh Grapes by Heat.*

		Color.		Tannin.	Acid.
		Tint.	Intensity.		
1. Witness. (Ordinary fermentation at 30° C.)		2 VR	66.6	.357	.45
2. Heated to 50° C. in one hour	1.00 hour	5 VR	19.3	.108	.38
(*a*) Kept at 50° C. for 30 minutes longer	1.50 "	3 VR	37.7	.135	.37
(*b*) Kept at 50° C. for 90 minutes longer	2.50 "	2 VR	74.0	.217	.30
3. Heated to 60° C. in 80 minutes	1.30 "	VR	95.0	.328	.50
(*a*) Kept at 60° for 60 minutes longer	2.30 "	*VR+	133.0	.385	.45
(*b*) Kept at 60° C. for 120 minutes longer	3.30 "	VR+	174.0	.500	.52
4. Heated to 70° C. in 90 minutes	1.50 "	VR+	138.0	.246	.48
(*a*) Kept at 70° C. for 45 minutes longer	2.25 "	VR+	160.0	.369	.46
(*b*) Kept at 70° C. for 90 minutes longer	3.00 "	VR+	160.0	.450	.46
5. Heated to 65° C. in 3 hours and 20 minutes, after adding 10.5% alcohol†		VR	120.0	.552	.38

*The + indicates the color brighter than the first tint of the colorimeter.
†Corrected for dilution and contraction due to the addition of alcohol.

With regard to the extraction of color, an inspection of the intensity shows that heating the grapes for two hours and a half at 50° C. (122° F.) extracted more color than an ordinary fermentation at 30° C. (86° F.), while heating them for about the same time at 60° C. (140° F.) or one hour and a half at 70° C. (158° F.) extracted about twice as much. Still longer heating extracted still more color, the maximum being about three times that of the ordinary fermentation. It may be noted at the same time that the kind of color or tint was in all cases better than that of the fermented wine, except where the heating had been insufficient. Heating for one hour and a half at 50° C. was insufficient to properly extract the color, either as regards tint or intensity. In all the other cases the color was not only better than that of the fermented wine, but extended beyond the limits of the scale toward the VR end, showing that it was better than that of any wines ordinarily found in France where the scale is adopted.

It has been objected that the color extracted by heat in this manner is of a different nature from that extracted by fermentation, and that most of it would be deposited by the alcohol formed during fermentation. The fifth experiment, at the bottom of the column, shows that, while this may be partly true, yet with the addition of 10½% of alcohol before the heating, twice as much color was extracted in 3½ hours at 65° C. (149° F.) as by fermentation, and that the tint was better.

In order to test whether this destruction or precipitation of color by the alcohol continued on further contact, the tests summarized in the following table were made.

A quantity of Lagrein grapes from Tulare was crushed and heated to 70° C. to extract the color. The must contained 27.4% of solid contents by spindle and .47% of acid calculated as tartaric. The color of the must at the commencement of the experiment (September 23, 1899) was VR 85.3. The colored must was placed in ten bottles holding 125 c.c. each, and various amounts of alcohol added to each. Two series were made, to one of which was added .4% of tartaric acid. The bottles were filled quite full, well corked, and sterilized at 60° C., in order to eliminate as much as possible the influence of oxygen and fermentative organisms.

TABLE II. *Effect of various amounts of Alcohol and Tartaric Acid on the Stability of the Coloring Matter of Red Grapes. Color after 6½ Months.*

	No Acid Added.		Acid Added.	
	Tint.	Intensity.*	Tint.	Intensity.*
1. Must + 0% of alcohol	2 VR	57.9	3 VR	58.8
2. Must + 5% of alcohol	2 VR	53.2	3 VR	56.9
3. Must + 10% of alcohol	3 VR	39.6	3 VR	57.7
4. Must + 15% of alcohol	3 VR	41.1	3 VR	55.8
5. Must + 20% of alcohol	4 VR	41.2	4 VR	56.6

*These figures are corrected for the dilution and contraction due to the addition of alcohol.

No. 1 shows that the must to which no alcohol was added lost 32% of its color in six months, and that this loss was not prevented by the addition of a considerable quantity of tartaric acid. The must to which was added 5% of alcohol lost 38% of its color, and that with 10% of alcohol 46%. The addition of 15% and 20% of alcohol had no more effect in destroying coloring matter than 10%, though there was a slight degradation of tint. The last column shows that the addition of tartaric acid was very effective in counteracting the effect of the alcohol, as the loss of color due to alcohol where tartaric acid was added averaged only 34%, or very little more than that of the pure must.

That heating the grapes is equally effective in extracting the tannin is well shown by Table I. The tests indicate that, with the grapes used, sufficient tannin is extracted before the maximum color extraction is reached. They also indicate that there is danger that too long or too high heating may extract too much tannin, and that it may be impossible to get the maximum color extraction without getting too much tannin. However, test *4a* shows that twice the color may be obtained by heating to 70° C. (158° F.) for an hour and a half before the tannin-content reaches that of an ordinary fermentation. With further heating more tannin may be obtained, and the maximum was not reached in any of the tests. Undoubtedly, prolonged heating would dissolve some of the tannin in the seeds, so that the astringency could probably be increased as much as desired, even with grapes normally lacking in tannin. The presence of too much tannin is much less dangerous than too little, as it increases the keeping qualities of the wine and disappears gradually with age or can be removed to a great extent by fining. Moreover, Professor Barba has shown that the tannin in the must is very rapidly eliminated if the must is kept without fermentation.* If, therefore, it is necessary to heat the grapes for a long time to extract the color, the superfluous tannin can be diminished to any desired extent by delaying the fermentation.

These laboratory experiments demonstrated the probability that color and tannin could be extracted by heat, the red must separated from the pomace and fermented in the same manner as white wine. If this could be done without deterioration of quality from some unforeseen cause, a great advance would have been made in the certainty of making good wine in hot localities. The cool fermentation of must without the pomace is a comparatively simple operation.

While these laboratory tests were in progress, corresponding winemaking tests were undertaken in the cellar to throw light on the feasibility of the method in actual practice.

About three quarters of a ton of red grapes was obtained from the Tulare Experiment Station. These grapes were grown in black, alkaline, sandy soil in one of the hottest regions of the State, where all the conditions which are supposed to render a hot region unsuitable for the production of dry wine are at their worst. The grapes consisted of Lagrein 75%, Malbec 14%, and Valdepeñas 11%, and the mixture contained 24.64% of fermentable sugar and .34% of acid calculated as tar-

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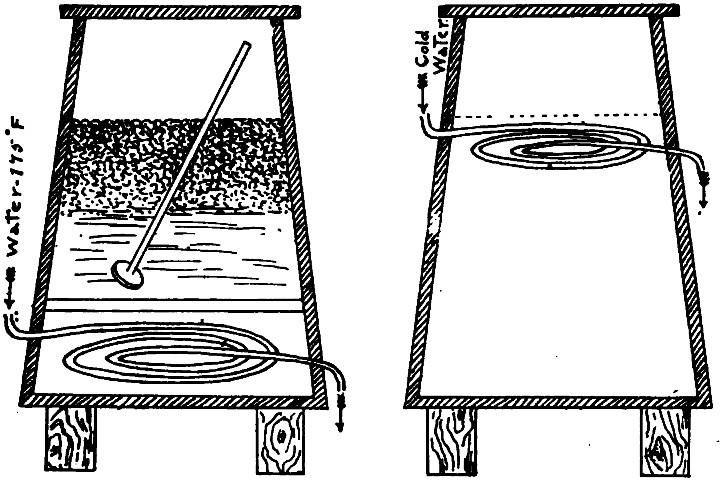
* Barba, M., in "Annales de la Société des Viticulteurs de France," vol. VI, p. 100:

Tannin in must of heated grapes immediately after heating	.910
Tannin in wine of heated grapes fermented immediately after heating	.820
Tannin in must of heated grapes one day after heating	.720
Tannin in must of heated grapes four days after heating	.260

taric. The grapes were therefore totally unfitted for the production of dry red wine by the ordinary methods of wine-making. Grapes with such high sugar-content and low acidity would fail to ferment dry, not only in the San Joaquin Valley but in any part of California, and, in nine cases out of ten, the tanks would almost certainly "stick" in fermentation, and the wine spoil before it was three months old. No grapes more suitable to detect any weak point in the method could have been chosen.

One-fifth of the crushed and mixed grapes was fermented in the ordinary way in an open fermenting vat. More than the usual care was taken, the grapes being thoroughly stirred twice a day and the vat kept covered. The fermentation was cool, never exceeding 79° F., and the wine was nearly dry at the end of thirteen days.



Heating Vat. *Cooling Vat.*

FIG. 1. Heating and Cooling Vats. Showing the plan adopted for heating the grapes and cooling the must before fermentation.

The other four-fifths of the crushed grapes was placed in a small fermenting-vat, which they about two-thirds filled. At the bottom of this vat was a coil of half-inch block-tin tubing, through which a stream of water of a temperature of 80° C. (176° F.) was run. The vat was then covered with a canvas sheet, which was removed every half hour and the heating grapes thoroughly stirred. The heating commenced at 10 A. M., the temperature of the grapes being 18.5° C. (65° F.), and continued until 4 P. M., when the temperature of the grapes had risen gradually to 48° C. (118° F.). The red must was then drawn off and mixed with the must pressed from the heated pomace, and placed in an open vat (see Fig. 1).

The color of the must, as it ran from the heater, was 1 VR—78, and of that which ran from the press VR—102. The amount of tannin in the mixture was .262%. The must was cooled, immediately after mixing, to 30° C. (86° F.) by means of a coil similar to the heating coil, through which water at 20° C. (68° F.) was run. It was then divided into four equal lots, numbered 2717*a*, 2717*b*, 2717*c*, and 2717*d*, each of which was placed in a separate keg. Nos. 2717*b* and 2717*d* each received an addition of tartaric acid. Fermentation was started by the addition of yeast and was finished in all cases in twelve days, the temperature being practically the same as that of the ordinary fermentation, never exceeding 26° C. (79° F.). As soon as the wines were dry they were racked into clean casks, kept for a few days in the fermenting-room at 21° C. (70° F.), and as soon as clear racked again and put in the cool storage cellar. The wine fermented in the ordinary way received the same treatment after fermentation. Some of the data obtained are shown in the following table:

		Must.	Wine.					
		Acid.	Acid.	Tannin.	Alcohol.	Solid Contents.	Time of Fermentation.	Color.
Witness:	2717	.34	.38	....	....	....	13 days	3 VR 30.7
Heated grapes.	2717*a*	.54	.41	.151	14.25	3.15	12 days	2 VR 29.2
	2717*b*	.60	.60	.153	14.10	2.81	12 days	2 VR 35.7
	2717*c*	.44	.47	.153	13.90	3.15	12 days	2 VR 25.0
	2717*d*	.53	.53	.139	14.10	2.60	12 days	2 VR 32.0

The four wines made from the heated grapes were bottled when they were eighteen months old, and were in excellent condition. They remained in the cellar four years, when they were opened and tasted. They were all perfectly sound and clear. A thin, tightly adhering deposit had been formed in the bottles, proving by its character the perfect keeping-qualities of the wine. The wines were fresh, clean tasting, and of good color. The bouquet was remarkably strong, proving conclusively that heating the grapes to 48° C. does not diminish this quality in the wine, and even tending to show that, on the contrary, it increases it.

This series of tests has clearly demonstrated a fact of great importance to wine-makers of the interior valleys, viz: that grapes grown in rich, sub-irrigated soil in the hottest part of the valley can, if properly handled, be used for the production of not only a sound dry red wine, but of a wine of exceptional quality, superior in every respect to the *bulk* of the wines produced in any part of California or of Europe. Whether fine wines, equal to the best of the Médoc and Burgundy or of the coast valleys of California, can be produced there is a matter of much less importance at present, and can be left for the future to decide.

ADDITION OF SUBSTANCES DEFICIENT IN THE GRAPES.

Water.—One of the most frequent causes of difficult fermentation and spoiled wine, when the attempt is made to make dry wine in a hot climate, is extreme sweetness of the grapes. Under the most favorable conditions it is impossible to cause the transformation into alcohol of more than about 28% of sugar in the must, and this only after a very long time. Under ordinarily favorable conditions it is impracticable to ferment out more than 25%, producing 14.5% of alcohol. Under the conditions existing in an ordinary cellar in a warm locality the limit is much lower, and may be taken as somewhere about 22% of actual fermentable sugar, corresponding to between 22.5% and 23% on Balling's saccharometer, and capable of yielding a wine containing 13% of alcohol. Even with this amount of sugar, most of the fermenting vats will "stick" with 2% to 4% of unfermented sugar in warm seasons with ordinary methods of wine-making. Grapes containing only 19% of fermentable sugar can, however, be nearly always fermented dry with the ordinary methods, except in very hot seasons or where very large fermenting-vats are employed.

As about three quarters of the weight of ripe grapes consists of water, the addition of a little more when there is too much sugar naturally suggests itself. The procedure has been and is still frequently used, but often with but indifferent success. The reasons for failure are two: Firstly, the dilution of the sugar entails at the same time the dilution of the other constituents of the must, notably the acid; and secondly, impure water is often used, water containing large amounts of salts or of organic matter, which materially alters the flavor of the wine and the character of the fermentation. The dilution of the acid is the most serious defect, and is the more serious the riper the grapes, for the more sugar there is present usually the less there is of acid. For example: if we dilute a must containing 24 grams of sugar in 100 c.c. (about 24.4%, Balling) and .4% of acid to 22½ (23.2%, Balling), by adding 7% of water we also reduce the acid, which is already too low, to .37%. Wherever dilution is practiced, therefore, it is almost always necessary to supplement the acidity. Moreover, the practice can be used successfully only where the grapes are naturally high in extract and coloring matter. In other cases the wine will be thin and flat. There is a well-founded prejudice against adding water to wine either before fermentation or after. This has its origin, to a great extent, in the fact that in Europe the addition of water is done for purposes of fraud, with the simple object of making more gallons of wine out of a given quantity of grapes. The addition of water to the wine after the fermentation is never admissible under any circumstances, as it can never improve the quality in any way, and will, in fact, always injure it. There are, however, cases where it is possible, by a limited amount of dilution before fermentation, to produce a good, sound, dry wine, where it would be very difficult to do so without. This applies particularly to California, where the richness of the grapes in all constituents except acid is often so great that even after the addition of a certain amount of water to the must the resulting wine has a higher degree of alcohol and extract than the bulk of European wines, and could not be recognized as watered by any "alcohol and acid" or other chemical or organoleptic test. However, the practice is to be commended only under exceptional circumstances, as there are almost always better ways of attaining the object—a thorough, clean fermentation.

Tartaric Acid.—This acid is found in larger or smaller amounts in all grapes and in all wines. Some of the acid exists "free" (that is, uncombined with any base), but most of it occurs in combination with potash and lime. The principal acidity of most grapes and wines is due to the acid salt of potash and tartaric acid, bitartrate of potash, more commonly known as cream of tartar. Malic acid and its salts also occur in considerable amounts, and some other acids in very small amounts. Thus the acidity of a must is due to a number of acids and acid salts, which vary somewhat in their proportions as well as in their total amounts in various grapes and at various stages of ripeness. In unripe grapes the free acids predominate; in ripe, the acid salts.

The importance of the acidity of the grapes in wine-making is so great that no wine-maker should be without the means of determining its amount. It is not necessary to know the exact amount of each constituent of the acidity, and to determine it would be difficult and impracticable in wine-making; but some measure of the "total acidity," which will give us an idea of its effect on the fermentation and on the quality of the wine, is both useful and necessary. This may be found in various ways, but the results are always given as sulfuric or tartaric acid. That is, when we say a must has .8% acid as tartaric, we mean that its acidity has the same effect on the reagents used in determining it as .8% of pure tartaric acid would have. This does not give us the exact amount of tartaric or of any of the acids in the must, but as the various acid constituents occur in about the same relative proportions in all grapes that are not very unripe, it gives us a convenient way of comparing different grapes and of judging whether their acidity is sufficient for our purpose.

The acidity affects the quality of the wine both directly and by its effect on the fermentation. A dry wine requires a certain amount of acidity or it will taste flat—a red wine with insufficient acidity drops its color very rapidly. Its most marked effect, however, is due to its influence on the fermentative organisms in the must. Yeast will multiply and grow in presence of a larger amount of acid than any of the ordinary disease germs and bacteria occurring in must and wine. For this reason a very acid must nearly always undergoes a clean and thorough fermentation, and the resulting wine clears rapidly and keeps well.

It is impossible to say what the most desirable degree of acidity is, as this varies with so many conditions. Red wine requires more than white, as the former loses much in fermenting. Coloring grapes, such as the Bouschets, require more than ordinary red grapes, as the coloring matter is less stable. American grapes, such as Lenoir, require still more, as they are liable to a peculiar change when lacking in acid, which destroys their color. Moldy, unripe or otherwise defective grapes require more than good grapes, on account of the large numbers of bacteria and molds they contain.

According to Bouffard,* the average acidity of good red wines in the south of France is .6% to .9%. Good wines may have less than this, but they are then difficult to handle. As some of the acidity is lost in fermentation, the must should have more than this. Roos † gives as the most favorable acidity for red wine grapes in the south of France, the following:

For Aramon, Carignane, and most red grapes	0.8%
For Bouschets	1.0%
For Jacquez (Lenoir)	1.2%

The acidity of ripe California grapes very rarely reaches these figures, especially in the hotter parts, and this lack greatly intensifies the unfavorable effect of hot fermentation. Even in the south of France the grapes very commonly fall below these figures when allowed to mature completely. There, the difficulty is usually overcome by gathering the grapes under-ripe, to the detriment, as already observed, of both quality and quantity. In large vineyards, however, it is often impossible to gather all the grapes before they are thoroughly ripe, so the augmentation of the acidity by addition of acid to the grapes or wine is becoming a common practice both there and in Algeria. The addition of the acid to the wine after fermentation is practiced only when its object is to increase the acidity for the taste of certain French markets, or to increase the stability of the coloring matter in wine from color-grapes. Jacquez wine is sometimes dosed with tartaric acid to the extent of 2%, which makes it quite undrinkable but useful to blend with wines lacking in both acid and color. Tartaric acid added to the wine after fermentation gives a harshness to the wine which is absent when the acid is added to the must before fermentation. The only object of adding it after instead of before is that a certain proportion is precipitated, and this in the latter case is lost in the pomace or thick lees, while in the former it is recovered in the argol deposited in the casks.

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* "Revue de Viticulture;" vol. 10, p. 545.

† Roos: "L'Industrie Vinicole Meridionale." Montpellier, 1898.

For the purpose of regulating the fermentation, however, it must be added to the crushed grapes, and in this case, unless used in extravagant quantities, it has absolutely no ill effects on the flavor of the wine. How much it is necessary or safe to use can be determined only by experiment in each vineyard with each variety of grape. In a general way, it may be said that experience has shown that with grapes very low in acidity it is neither safe nor necessary to add enough acid to bring up the amount to the figures given by Roos as normal. For example, if a must shows .4% of acidity it is usually sufficient to add enough tartaric acid to bring this acidity up to .6%, that is 4 pounds to the ton of grapes. Some writers say it is rarely desirable to exceed 2 pounds to the ton,* while others believe it is quite admissible to go as high as 5, 6, or even 8 pounds per ton.† In general, the best modern practice seems to be not to exceed 4 pounds per ton,‡ and this in all cases is sufficient to insure a good fermentation so far as acidity alone can do this. The reason of this is that the addition of a certain amount of tartaric acid to the must has a much stronger effect on regulating the fermentation than an equivalent amount of natural acidity, because it increases the "free" acid and diminishes the "combined acid" or cream of tartar. The former has a much more deterrent effect on bad ferments than the latter, but when in great excess it also has an unpleasant harshness to the palate. When we add tartaric acid to a must or wine we get an increase of free tartaric acid in the liquid, but at the same time we get a diminution of cream of tartar. The chemical reactions to which this is due are obscure and complicated, but it is partly due to the fact that the more free tartaric acid there is present the less capable the wine is of keeping bitartrate of potash in solution. The addition of tartaric acid always causes, therefore, a deposit of cream of tartar, and therefore the increase in the acidity of the resulting wine is less than corresponds to the amount of acid added. In a general way we may say that we usually find in the wine about two-thirds of the acid added to the must. The amount will vary, however, according to conditions. If added directly to the wine we may increase the acidity by 70% of the acid used.* If added to the must only 47% may be found in the wine,§ while if added to the crushed grapes as little as 25%§ may remain.

There is very little danger of making the wine harsh unless the maximum doses recommended are very much exceeded; and a slight harshness due to good acidity diminishes with age.

Citric Acid.—This acid has been used extensively during recent years to cure or prevent a certain form of the disease of wines which the French call "la casse." Its efficacy in this respect, and the complete absence of any injurious effect on the wines treated, suggested its use in the acidification of deficient must, before fermentation, in place of tartaric acid. For this purpose it has been found equally efficacious and, from most points of view, superior to tartaric acid. The only objection to its use is the doubt as to the presence of citric acid as a normal constituent of grapes. Some investigators claim that it does exist naturally in grapes in minute quantities, and as only minute quantities are needed, and as the acid is as "innocuous and wholesome as tartaric acid," there seems to be no reasonable objection to its use. It is not and can not be used in any way to increase the quantity of wine made from a given quantity of grapes, but only to improve its quality. Its use can not therefore be considered a sophistication any more than that of sulfurous acid or finings.

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*Bouffard, A.: "Revue de Viticulture," vol. 10, p. 545.

†Sebastian, V: "Le Sucrage des Vins," p. 46. Montpellier, 1903.

‡Pacottet: "Vinification," p. 33. Paris, 1904.

§Fonseca and Chiaramonte, quoted by Pacottet, P.: "Vinification," p. 74.

Citric acid has several advantages over tartaric. It does not give the harshness to the wine which some tasters find in case of large additions of tartaric. It does not cause precipitation of the cream of tartar, but on the contrary makes this latter slightly more soluble. This, together with the fact that it seems to have a slightly more deterrent effect on bacteria than tartaric, makes it possible to get the same effect with a much smaller amount. From one half to one third the amount is used. That is, for example, where it would be necessary to add 6 pounds of tartaric acid to a ton of grapes, from 2 to 3 pounds of citric acid would be equally effective.

It is essential that the citric acid should be pure. Citric acid is sometimes found on the market, marked for dyer's uses, which is adulterated with oxalic acid. This would be extremely injurious to the wine. There is, however, no difficulty now in getting pure citric acid in quantities at about 30 cents per pound, which is very little more than the cost of tartaric, and which, considering the smaller amounts needed, makes it more economical than the latter. Citric acid of suitable quality is now made in quantity in California from refuse and cull lemons.

Citric acid must not be confused with lemon oil or essence obtained from the skins of lemons and used for flavoring. Pure citric acid has a completely clean, simple, acid taste, without any lemon flavor whatever.

Plaster.—One of the oldest and most widespread methods of aiding the fermentation by increasing the acidity of the must is by the addition of ordinary plaster of Paris or sulfate of lime to the grapes. The plaster is sifted on to the grapes, as they come from the crusher, at the rate of between 4 and 8 pounds to the ton. The practice was formerly almost universal in southern France and similar climates, but it has been greatly restricted by a law passed in 1891, limiting the amount of sulfate of potash in wines to 2 grams per liter.

The effect of the plaster is to cause a better fermentation and to increase the keeping quality of the wine. It aids in the rapid clearing of the wine and increases and brightens the color. The chemical action is somewhat complex, but the final result is an increase in the acidity of the wine and of the sulfate of potash. The lime sulfate acts on the potash salts existing naturally in the wine, forming insoluble lime tartrates, which are deposited, and soluble sulfates and acid sulfates, which remain in the wine. The acid sulfates finally take the potash from the organic salts and become neutral sulfates of potash, setting free the organic acids to increase the acidity of the wine. When plaster of good quality is used it is a very cheap, effective, and easily-applied means of assisting the fermentation, and is greatly in favor among the wine-makers of nearly all warm regions. While very helpful in obtaining a sound, clear wine of good keeping qualities, it gives a certain harshness which is inadmissible for fine wines. Many samples of plaster, moreover, contain carbonates, which make its use very unreliable, and if present in any considerable quantities neutralize more of the natural acidity of the wine than is set free by the sulfate.

The question of the harmful effects, on health, of wine containing sulfate of potash is still in dispute. The law in France, however, limiting the amount that a commercial wine may contain to 2 grams per liter, makes impossible the use of enough plaster to have the desired effect on the fermentation. For this reason its use is much more restricted than formerly. Some wine-makers use it in conjunction with tartaric acid, using as much plaster as possible without exceeding the legal limit of sulfate in the wine, and making up the deficiency with tartaric acid.

Phosphates.—Latterly many wine-makers in Algeria have been using bi-basic phosphate of lime in the same way as plaster. It is sifted on to the crushed grapes in the same way and produces very much the same effect. It is superior to plaster, as it does not give the harshness due to the latter, and does not increase the sulfates. Acid phosphates of potash are left in the wine and the lime is deposited as neutral lime tartrate. Nothing injurious is left in the wine, and the phosphates doubtless aid the completion of the fermentation. It has, however, the same defect of being unreliable, as its action is very variable and it is impossible to foretell the effect of a certain dose.

CONTROL OF FERMENTATION.

MODIFYING THE TEMPERATURE.

All the fermentations, good and bad, to which must or wine is liable are caused by micro-organisms which get into the liquid either from the outside of the grapes or from the crushers, casks, etc., with which the liquid comes in contact. These micro-organisms, which thus get into the must, consist of yeasts, molds, and bacteria of a very great number of kinds. Few of these kinds, however, can grow in the must, and under the best conditions of wine-making practically none grow but the true wine-yeast. A perfectly clean or pure fermentation is one in which no micro-organism takes part except the true wine-yeast. This is the ideal condition toward which the wine-maker's efforts should tend. It is, however, by no means essential for the production of good wine that this condition should be reached. All that is necessary is that the true wine-yeast should vastly outnumber all the others, and that nothing should interfere with its healthy and complete action. In the finest château wines, molds and false yeasts occur in the first stages of fermentation, but the conditions of wine-making are such that they have little or no perceptible effect on the must before the true wine-yeast commences its action. This action soon overcomes all others and, if nothing interferes with it, the wine is given a stability which makes it a simple matter to prevent all ulterior action of injurious fermentative agents.

The main problem of wine-making, then, after we have obtained the best possible raw material, is to produce a clean fermentation. This is to be accomplished in one or both of two ways: (*a*) by establishing conditions favorable to the growth of wine-yeast and unfavorable to the growth of the other organisms; and (*b*) by eliminating the other organisms and having as little present as possible in the must but pure wine-yeast. One of the most essential conditions is established when our raw material is of proper composition, that is, when the various substances in the grapes, especially the acid and sugar, are in the proper proportion. This is all that is necessary in a cool climate to insure a clean fermentation if the presence of too many unfavorable fermentative organisms is prevented by ordinary care and cleanliness. In a hot region, on the other hand, however favorable the composition of the grapes and however cleanly the methods of handling them, a thorough, clean fermentation is rarely obtained unless we control other conditions. The principal of these conditions is the temperature. The *use* and *necessity* of a high temperature to properly extract the grapes have already been pointed out. The *danger* of high temperatures consists principally, in practice, in their effect on the fermentative organisms.

The injurious effects of too much heat during fermentation are of two kinds, which should be carefully distinguished. In the first place, high temperatures encourage the growth of the bacteria which cause most of the spoiling of wine. In the second place, the chemical actions which the yeast brings about in the must at a high temperature are different from those which it causes at a low temperature. The first effects would be prevented by any means which excluded the presence of bacteria in the fermenting must; the latter are dependent only on the yeast. It is possible to ferment completely all the sugar in any sterilized must which does not contain more than 26% at any temperature between 15° C. (59° F.) and 35° C. (95° F.); but the qualities of the wine made at the two temperatures will be very different. Leaving out of account the extractive effects, a wine fermented near the lower limit will be smoother, fresher, and contain more alcohol and bouquet than one fermented near the higher. In practice, a wine fermented at the higher temperature may be more valuable on account of the greater color, tannin, and body it contains, if these latter characteristics are what constitute its main value.

It is the failure to properly distinguish between these two effects of heat that causes the wide discrepancies between the figures given by various authorities as to the most favorable temperature for wine-making. The finest Rhine wines are kept at about 15° C. (59°F.) during the greater part of the fermentation, while in Algeria it is considered, by most wine-makers, advisable to allow the temperature to rise to 35° C. (95° F.). In the former case the most valuable characteristic of the wine is its bouquet and aroma, which would be destroyed at high temperatures, while in the latter the color, body, and tannin, which constitute the main value of the wine, would not be sufficiently extracted from the skins at a lower temperature. In the Médoc and Burgundy districts it is considered desirable to keep the wine during fermentation at between 25° and 30° C. (77° and 86° F.). This is low enough not to destroy either the freshness or the bouquet, and high enough to extract the skins sufficiently with the thorough stirring and long maceration practiced in these regions.

In hot regions, like those of Algeria, and most parts of California, all considerations give way to the necessity of finding means of making a *sound* wine, which is the first essential. For this purpose the temperature will in these regions nearly always rise too high unless means are taken to prevent it.

COOLING DEVICES (PHYSICAL).

The temperature to which the fermenting grapes rise is determined by the heat they contain when crushed, *plus* the heat generated by fermentation and *minus* that lost during the process by radiation and conduction. The warmer the grapes and the more sugar they contain, therefore, the higher the temperature will rise. The smaller the fermenting mass, the cooler the air, the greater the conductivity of the vats, and the slower the fermentation, the less the temperature will rise. Gathering the grapes only in the early morning, or leaving those gathered in the hot part of the day exposed to the night air before crushing, is a very effective way of controlling the temperature in small cellars. In large cellars this is impossible, owing not only to the practical difficulties of finding receptacles for the grapes, but to the fact that however cold the grapes are crushed, the temperature of large masses will rise above the danger point unless the heat of fermentation is eliminated in some way. Professor Bouffard* has shown experimentally that 180 grams of sugar give out at least 23.5 calories during fermentation. This means that 22% of sugar in a fermenting must is capable of generating enough heat to raise the temperature about 90° F. If none of the heat were lost, therefore, a must containing 22% of sugar and commencing fermentation at a temperature of 60° F. would reach 100° F. and "stick" while it still contained 12% of sugar. In practice some of this heat is always lost, but with hot weather and large vats it shows that it is possible for the fermenting must to "stick" however low in sugar-contents it may be, and however cool the grapes are when crushed. Cooling the grapes or must, therefore, is only a partial remedy, and quite insufficient to insure thorough fermentation unless supplemented by some other means.

Aids to Radiation.—Any means which promotes the radiation of heat from the fermenting mass tends to moderate the rise in temperature. One such means is the use of small fermenting vats. The smaller the vat the greater will be the surface from which heat radiates in proportion to the volume of the mass of grapes. For example, a fermenting vat of the ordinary form, containing 100 gallons, will have a radiating surface, reckoning the top, bottom, and sides, of about 31 square feet, or .311 square foot for every gallon of crushed grapes it contains, while one of 1,000 gallons will have about 144 square feet, or .145 square foot per gallon, and one of 10,000 gallons about 670 square feet, or only .067 square foot for every gallon. How little the radiation from even the smallest vats used in commercial cellars can be depended on to keep the temperature below the danger point is familiar to every practical wine-maker. Numerous experiments made at Berkeley make this point certain.† To quote one: Two hundred pounds (about 25 gallons) of crushed grapes were placed in a small vat and allowed to ferment in the ordinary way with three stirrings daily. The temperature of the room varied between 72° and 75° F., and the grapes showed 63° F. when crushed. Notwithstanding these favorable conditions of cool grapes and small vat, the temperature rose to 94° F. during fermentation. The grapes contained about 24% of sugar, which, according to Bouffard's tests, would produce enough heat in fermenting to raise the grapes from their initial temperature of 63° F. to about 120° F. Radiation thus got rid of 24° F. by the time the fermentation reached its maximum. In a 10,000-gallon vat radiation could have removed, providing all other conditions were the same, only one-seventh of this amount, and even in a 1,000-gallon vat only three-tenths, which would not have been enough to prevent arrest of fermentation long before the sugar was all gone.

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* "Progrès Agricole et Viticole," vol. 24, p. 345.

† E. W. Hilgard: "Methods of Fermentation," p. 15. See exp. 732. Report of Agricultural Experiment Station, Berkeley, 1888.

Vats smaller than 1,000 gallons are not practicable, even in small cellars, so that control of temperature by diminishing the size of the vats is incomplete and impracticable for California conditions. The same may be said of vats of special forms. Very high, narrow vats such as are used by brewers, or very wide, shallow vats as used in some wineries, radiate more heat than vats of the ordinary form; but the difference is so little under ordinary conditions that it can not be depended upon to prevent "sticking." A 3,000-gallon vat with a depth of 6 feet presents a radiating surface of about 313 square feet, while one of the same capacity with a depth of only 3 feet has 388 feet of radiating surface. The difference in radiated heat is no doubt greater than is indicated by these figures, as most of the radiation takes place from the upper surface of the pomace, which in the shallow vat will have an area of about 125 square feet, and in the deep vat only about 55 square feet. The difference is not enough, however, to keep the temperature sufficiently low, except in small vats and in cool weather.

Various forms of gratings for submerging or dividing the pomace have been in limited use as aids to cool fermentation. They are attempts to counteract the tendency of the pomace to rise to the top and form a semi-dry "cap" where the heat becomes excessive, even when the must below keeps comparatively cool. Some of these gratings keep the pomace near the bottom of the vat, where it can not become hotter than the must above, owing to the tendency of the cooler must to sink on account of its greater specific gravity. Others are arranged with the object of promoting the continual circulation of the must through the cap, and thus preventing any part becoming hotter than the rest. These appliances are all very troublesome to use, and at the best are only palliatives. Frequent stirring (foulage) of the fermenting mass is almost equally effective and is more easily applied.

An ingenious method of cooling, at one time discussed a good deal and tested to some extent in Algeria, is that of Toutée. It is based on an attempt to increase the heat radiation from the sides of the vats. With the ordinary wooden vat and still more with stone or concrete vats, there is very little radiation, except from the top of the grapes exposed to the air. Toutée constructed vats of metal, where the radiation from the sides was so much increased that, except in warm weather, white must was kept sufficiently cool in 3,000-gallon vats. With red grapes, owing to the presence of the pomace, the effect was less, unless continued stirring or pumping-over was practiced. A vital defect of the system was its cost and the necessity of replacing the vats on hand.

"*Pumping-over*" is an operation resorted to very frequently in Algeria and France as in California for promoting a dilatory fermentation. Its rationale is not always, however, well understood. It is not properly a method of cooling. In fact, it generally has the other effect. The only case in which it really cools the must is near the end of the fermentation, when it is desirable to prevent cooling in order not to check the action of the yeast. It is often, nevertheless, very effective in producing a thorough fermentation. This it does, not by cooling the must, but by providing the yeast with an abundance of oxygen, which strengthens and stimulates it and enables it to attack the sugar more forcibly. It is very effective and useful at the beginning of the fermentation in cool weather, or when real cooling means are applied as well. In hot weather it is more likely to increase the trouble, and toward the end of fermentation it entails a loss of alcohol and a vapid taste, which may more than offset any benefit derived.

Attemperators and Refrigerators.—The failure, in the majority of cases, of all the methods previously discussed, long ago led the wine-makers of Algeria to look for some more effective and reliable method of controlling the temperature. This they have found, after many trials, in two or three forms of machines known by the above names. An *attemperator* is an appliance—usually a long spiral tube—which is placed in the fermenting-vat and through which *water* or other cooling liquid is run. A *refrigerator* is an appliance—also usually a spiral tube—outside the vat, through which the *wine* is run, and which is cooled by a cold liquid on the outside. Innumerable forms of both classes of machines have been tested, but only a few have come into general use.

A very efficient form of attemperator is that used at the Government wine cellar of Constantia in Cape Colony and in some Australian cellars.

Fig. 2 will make clear the principles involved. Each vat is furnished with a grating by which the pomace is kept submerged several inches below the must, and with a small pump for bringing the must from the bottom to the top. When the temperature rises to the point which it is not desired to exceed, a copper coil is placed in the must above the grating and attached to a water tap. Cool water running through this coil soon brings down the temperature of the supernatant must. In the meanwhile the pump, which is attached to a shaft which works all the small vat pumps, is started, and a continuous but slow flow of liquid is established, which is cooled as it comes in contact with the coil on top and cools the pomace as it passes through. This arrangement gives very perfect control of the fermentation, with comparatively little labor. In vats of one or two thousand gallons the temperature can be kept at any point desired, and the extraction of the pomace can be increased or diminished very considerably by the more or less constant working of the vat pumps. Whether the control of temperature or the extraction of the pomace would be as complete in large vats where the pomace cap beneath the grating was very thick, is doubtful.

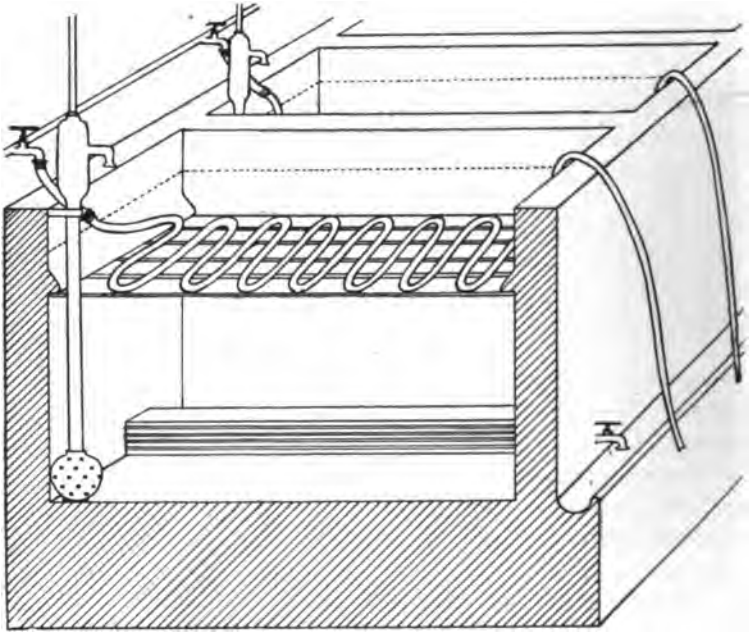

FIG. 2. Cooling device for fermenting-vat.

The method, however, is excellent in small or medium-sized cellars, where the object is to make wine of high quality. Its principal objection is the initial expense.

Cheaper attemperators have been made consisting simply of coils of copper or varnished galvanized iron piping placed around the inside walls or in various other positions in the vats. They are all efficient enough for the cooling of white wine where there is no solid matter present, but are quite inadequate for the case of red wine, and fail almost completely to prevent undue heating in the cap, except in small vats where continuous stirring can be practiced.

Refrigerators.—Appliances of many forms arranged for the cooling of the fermenting must outside the vat have been devised and tested. Only two types are in extensive use at the present time, however. The more common of these is that originated by Müntz and Rousseau,* which is made by several manufacturers of cellar appliances. It consists of a series of horizontal, superposed copper tubes, connected in such a way that the warm must enters at the bottom and emerges at the top. The cooling is obtained by causing water to drop or flow over the tubes from top to bottom. This form (Fig. 3) is useful especially where water is scarce, and is the type used almost exclusively in Algeria. There is probably not a single large cellar in Algeria, Oran, or Constantine which does not possess one or more of these machines, and by their use the production of a sound, completely fermented wine has become possible in all cases.

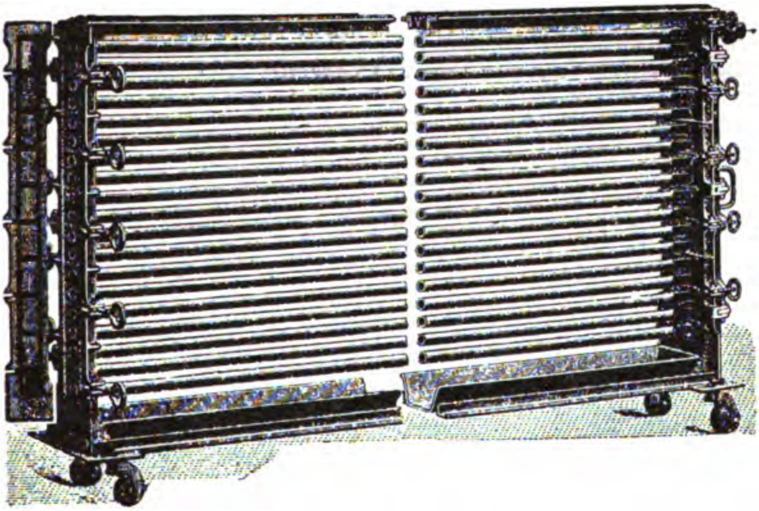

FIG. 3. Algerian type of refrigerator.

The amount of cooling necessary is indicated by the following example:

Grapes containing 20% of Fermentable Sugar.

Temperature of grapes when crushed	20° C.
†Heat liberated by fermentation of 20% of sugar	26° C.
Total temperature units	46° C.

In order, then, to prevent the temperature of the fermenting must from rising above 35° C., it is necessary to remove 11° C., or approximately 11 calories. That is to say, when the temperature reaches 35° C., if it is cooled to 24° C. the sugar will have all disappeared by the time it reaches 35° C. again, as shown by the following table:

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* See Bull. 117, Calif. Agr. Exp. Station.

† Calculated by using Prof. Bouffard's figure of 1.3 calories for each per cent of sugar.

Temperature.	Degrees of Temperature.		Per Cent of Sugar.	
	Gained.	Removed.	Removed.	Remaining.
20°				20.0
35°	15		11.5	8.5
24° cooled		11		
35°	11		20.0	0.0

This supposes that no heat is abstracted except that taken by the cooling machine. In practice, even in large concrete vats, a certain amount of heat is lost by radiation, so in the case above it would not be necessary to remove quite 11 calories. In California, with our sweeter grapes and hotter weather, it would be necessary to remove more heat than in Algeria and generally to cool twice. The following may be considered an average example:

Grapes containing 22% of Fermentable Sugar.

Temperature of grapes when crushed	70.0° F.
Heat liberated by 22% of sugar	51.7° F.
Total temperature units	121.7° F.

In order to prevent the temperature rising above 95° F. it would be necessary to remove heat equivalent to 26.7° F. or, allowing for a certain amount of loss by radiation and conduction, the cooler would have to remove about 20° F. It would be easier and probably more desirable to remove this by two coolings of 10° F. each than by a single one of 20° F.; easier, because it requires less time and less water of a given temperature to cool must from 95° to 85° than from 85° to 75°, and probably more desirable, as some observers claim that too much cooling at one time delays fermentation. The relation of the temperature with the disappearance of the sugar would then be somewhat as follows:

Temperature of Wine.	Degrees of Temperature.		Per Cent of Sugar.	
	Gained.	Removed.	Removed.	Remaining.
70°	0	0	0	22
95°	25		12	10
85° (first cooling)		10		
95°	10		17	5
85° (second cooling)		10		
95°	10		22	0

These figures in the temperature columns of the foregoing tables must not be understood to represent the actual temperatures found in practice. At no time would there be a fall of temperature from 95° to 85° F.

of the whole mass of fermenting grapes. This difference of 10 degrees simply represents the amount of heat which it is necessary to remove during one cooling, and is useful in indicating the amount and the temperature of the water needed. While the cooling is going on, fermentation and the production of heat continue, so that though the must passing through the cooler may be reduced 10 degrees or more, the whole mass in the vat will be reduced very much less or even not at all. The good effect consists, in the latter case, not in cooling the fermenting mass, but in preventing its temperature from rising any higher.

A description of the common Algerian practice in cooling will make this clearer. As a rule, the fermenting-vats are made of such a size that two of them will contain exactly the amount of grapes gathered in one day. One is filled in the morning and another in the afternoon. When the temperature of the first vat reaches 35° C. the faucet at the bottom is attached to a pump and the hot must passed slowly through the cooler and back into the vat again. The must as it leaves the cooler may have a temperature of 25° C. to 30° C., but it is fermenting and producing heat meanwhile as are the other contents of the vat, so that there may be very little if any apparent reduction of temperature in the vat. The sugar, however, is disappearing, until a time comes when, though the temperature of the vat may still be nearly 35° C., there is not enough sugar left in the must to heat it above that point. In fact, the usual plan in Algeria is to start pumping through the cooler as soon as the must reaches 35° C., and to continue this pumping until the fermentation is practically finished, that is, until only 2% to 3% of sugar is left. If the temperature is then, say, 34° C. and has never exceeded 35° C., there is no danger of the vat "sticking." This pumping through the cooler occupies eight or twelve hours for each vat, and is kept up night and day. This explains the arrangement of having two vats filled per day. One is cooled at night and the other during the day. Every vat is cooled, and cooled but once. When the weather is warm and the grapes very sweet, the wine is kept going through the cooler for a longer time. On the other hand, cool weather and grapes of low sugar-content necessitate less time. The size of the vats, the size of the cooler, and the amount of water should be so calculated that twelve hours' pumping in the hottest weather with the sweetest grapes expected will remove the necessary amount of heat from half the grapes crushed in one day. In hot weather, when the grapes are warm when crushed, it will be necessary to cool twice; but the total time of both coolings should never exceed the twelve hours, or an extra machine should be kept in reserve for exceptionally hot weather.

In order to show what a cooler of this type may be expected to do under California conditions, the following figures have been calculated on the basis of actual experiments made.* The estimate has been made for a cellar receiving a maximum of 100 tons a day in hot weather.* In cool weather more could be handled:

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* "Revue de Viticulture," vol. 7, p. 365.

Cooling by Müntz and Rousseau's Machine.

(Average case.)

Grapes containing 22% of sugar, capable of developing	51.7° F.
Temperature of grapes at crushing	70.0
Total degrees of temperature	121.7
Maximum temperature desired	90.0
Number of degrees necessary to be removed	31.7
Less 6.7° F. from radiation	25.0
Temperature of water	65.0
(If the must is cooled to 77½° F. as soon as it reaches 90° F. it would require two coolings to remove the necessary 25 degrees.)	
Wine to cool in 20 hours	24,000 gallons
Water required	48,000 gallons
Machines needed, 1. (Capacity of M. & R. machine, 2,400 gallons per hour.)	

If the grapes contained 24% of sugar and their temperature at crushing was 80° F. and that of the water available 70° F., which is an extreme case, two machines would be necessary and twice the amount of water. The cost of the water is merely nominal if the cellar is near an irrigating ditch. Recent investigations of pumping plants in practical use in irrigation show that on the average 300,000 gallons can be raised 10 feet for about $1.†

For a cellar of the size supposed, viz: one crushing about 100 tons of grapes per day, two coolers would be necessary, of the capacity of Müntz and Rousseau's largest size and an available supply of about 100,000 gallons of water per day, the temperature of which should never exceed 70° F. This would make it possible to prevent the wine ever surpassing 90° F., even in the hottest weather, and under average conditions not more than half the water and only one machine would be used.

Most of the large cellars of California are situated where they can obtain an abundant supply of water by pumping. This is especially true in the hotter regions, where irrigation is practiced. In this we have a great advantage over Algeria, where water is very frequently scarce. The various ingenious devices invented in Algeria for cooling the water before using would be of little use here, because it would hardly ever be necessary to use the same water twice, and cool water can be obtained in nearly all cases. Regular observations made by the Irrigation Department of the University of California show that the temperature of the main irrigating canals in the San Joaquin Valley during the wine-making season varies between 60° and 70° F., which is quite cool enough for the purpose.

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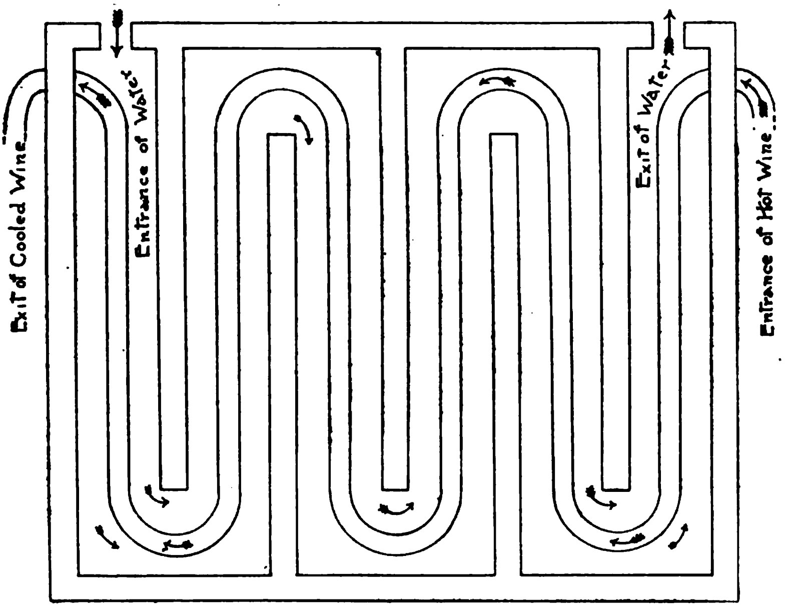
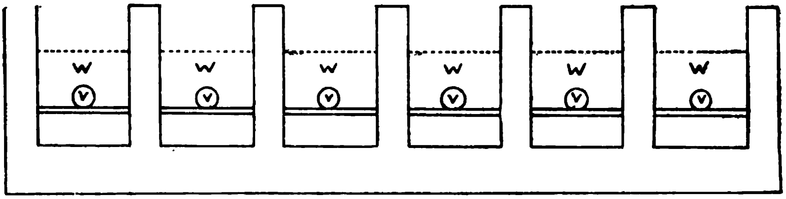
* Newer forms of this type of cooler are even more efficient. See "Progrès Agricole et Viticole," vol. 30, p. 19.

† S. Fortier: Circular No. 59, Office of Experiment Stations, Washington, D. C., p. 10.

Another type of cooler commonly used consists of a long copper or galvanized iron pipe laid in a long trough. The wine is pumped through the pipe and the water flows in the trough in the opposite direction. The device is simple, easily constructed at the cellar, and is not costly. Its main defect is that it does not thoroughly utilize the cooling capacity of the water, and much more water is necessary. Where large quantities of cool water are available, as near a main irrigating canal, it should be very useful. A good example of this type of cooler is in operation at the cellar of M. Gaston Gautier near Narbonne. At this cellar is made about 500,000 gallons of wine yearly. The trough is made of six walls of concrete about 2 feet high and 4 inches thick, so arranged that the water flows from one end to the other in a zigzag course. The galvanized iron* pipe through which the wine runs is laid near the bottom of this trough. The machine is said to run all the



Horizontal section.



Vertical section.

FIG. 4. Plan and section of a wine cooler at Le Grand Craboules, Narbonne.

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*The pipe should be *tinned*, not "galvanized," as in the latter case the zinc covering will be quickly *corroded* by the acids of the wine, and zinc will contaminate the wine.

season without cleaning, and remain effective to the end. At the end of the season the wine pipe is taken apart at the joints and cleaned. Such a cooler as this could be very easily constructed on the bank of an irrigating canal, or the piping might even be placed directly in the canal.

Ice.—The cooling power of ice might be used very effectively to prevent hot fermentations, if it could be obtained cheaply enough. For white wine, it is easily applied by placing the ice in a tinned copper tub floating on top of the must. The hottest must rises to the top and is cooled by contact with the tub and falls to the bottom. This creates a circulation of the liquid, which maintains a uniform temperature in all parts of the vat. For fermenting masses of crushed grapes this method is not applicable. In this case the ice could be used to cool the water used with an ordinary refrigerator. Five pounds of ice will reduce 100 gallons of must about one degree Fahrenheit. To reduce the must 20 degrees Fahrenheit, as in the case instanced on page 40, it would require over one pound of ice for every gallon of must. This may be taken as about the average cooling necessary, so that for every ton of grapes, when used for white wine, 200 pounds of ice would be needed, and about 300 pounds for the same amount of grapes when used for red wine. If used in connection with a water refrigerator, simply to increase the coolness of the water where only warm water was available, would require under ordinary conditions about the same amount.

The cost of cooling for ice alone would amount to about $1.50 per ton of grapes, reckoning ice at ½ cent per pound, which is about 1 cent a gallon for the wine made. This is much more than the whole cost of cooling, including labor, where it is possible to get cool water.

The method, which has been tested in California, of placing the ice directly in the vat with the idea of cooling and reducing the sugar at the same time, is quite inadmissible. The amount of ice necessary would introduce far too much water into the must.

CHEMICAL COOLING DEVICES.

The rise of temperature in a vat of fermenting grapes is due to the fact, already noted, that more heat is produced in a given time by fermentation than is lost by radiation and conduction in the same time. The heat produced is limited by the amount of fermentable sugar present; the heat lost, by the time of fermentation. If the fermentation is rapid the excess of heat produced, over that lost in a given time, will be great, and the rise of temperature correspondingly great. If on the contrary the fermentation is slow, the excess will be less and the rise of temperature less. If the fermentation is slow enough, the heat lost may equal the heat gained and no rise of temperature at all take place.

Anything, therefore, which retards fermentation will lower the maximum temperature to which the grapes will rise. Various substances may be added to the must which have this effect of retarding the course of fermentation. The only one which has come into practical use is *sulfurous acid* in some form. There are two sources of this acid which are at present extensively used in wine-making. When sulfur is burned it produces sulfurous acid gas. One pound of sulfur on burning yields two pounds of sulfurous acid. The other source is a salt of sulfurous acid, *potassium meta-bisulfite*, often sold commercially under the incorrect name of potassium sulfite. When this salt is placed in must or wine it is broken up by the acids in the wine, and yields sulfurous acid equal to 57% of its weight. The cost of the sulfite is about 23 cents per pound in France, and that of sulfur less than 2 cents. As the former yields only one fourth as much sulfurous acid as the latter, the cost of material is about fifty times as great. The difference in cost of material is in many cases, however, counterbalanced by the greater ease with which the sulfite can be used.

Sulfur.—The fumes of burning sulfur have long been used in the manufacture of white wine in all wine-making countries. The finest white wines of the Rhine and Gironde are sulfured in this way very heavily. Some of the finest of the former contain as much as .20 per mil. to .26 per mil. of sulfurous acid. Sauternes and Graves of the Gironde contain similar amounts. As this is many times as great as is needed for controlling the temperature, and as practically all that is used disappears from the wine during fermentation, the question of the legality or wholesomeness of the practice does not come into consideration in the making of ordinary wine. While the use of sulfurous acid has other advantages, especially in the making of the wines mentioned, in ordinary cases one of the chief benefits is the moderation of the rate of fermentation and the consequent lower temperature. For this purpose it is used extensively in southern France and to a less extent in Algeria. To give an idea of the moderation of temperature realizable in the fermentation of red wine, the following example may be given:* Two tests were made with two closed vats of 3,750 gallons each. One vat of each pair was sulfured and both filled at the same time with crushed Carignane grapes. In Nos. 1 and 3, 2.2 pounds of sulfur was burned before filling. When the temperature of these vats reached 86° F. the fumes from 1.1 pounds of sulfur were pumped into the must. Twenty-four hours later this treatment was repeated. Owing to the method of introducing the sulfur fumes there is no way of determining how much the must absorbed, but probably not more than 10% or 20% of the amount produced.

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* "Progrès Agricole et Viticole," vol. 29, p. 536.

Casks Nos. 2 and 4 were treated in every way the same as Nos. 1 and 3, except that no sulfur was used. The following table shows the results:

	Maximum Temperature	Drawn off at	Sugar Remaining.	Alcohol in Wine at 2 Months.
Vat No. 1, sulfured	93°	8 days	0	13.5
Vat No. 2, no sulfur	102	9 days	2	13.0
Vat No. 3, sulfured	95	9 days	0	13.9
Vat No. 4, no sulfur	104	10 days	2.5	13.3

In spite of the retarding effect of the sulfurous acid the fermentation in the sulfured vats finished first. Though the fermentation in the unsulfured vats was most rapid at first, the great heat developed stopped the action of the yeast before all the sugar had disappeared, so that the last 2% of sugar required several weeks to ferment out.

The alcohol in the sulfured wines was about a half per cent higher than in the others, a difference due in great part probably to loss from evaporation while pumping-over the latter at a high temperature.

The amount of sulfurous acid needed to delay fermentation is indicated by some tests made by Roos.* Must containing .05 per mil. of sulfurous acid fermented three fourths as fast as without any, and must containing .1 per mil. fermented less than one half as fast. These figures can be used only as indications of where to commence trials in practice, for the amount necessary will depend on a variety of conditions which differ for every cellar, viz, composition of must, temperature of grapes and cellar, amount of aëration, kind and quantity of yeast present, and size of fermenting-vats. The amount necessary depends especially on the amount and kind of yeast present. If the sulfurous acid is added before fermentation starts, a small amount delays fermentation considerably. In this connection Roos† gives the following figures as a guide to the use of sulfurous acid in clearing white must before fermentation:

To delay 10–12 hours	.030 gram per liter.
To delay 18–24 hours	.050 gram per liter.
To delay 48–60 hours	.075 gram per liter.
To delay 5–6 days	.100 gram per liter.

These results indicate that freshly expressed must, to which has been added the amounts of sulfurous acid mentioned, will not show perceptible fermentation until after the times mentioned. If these amounts of the acid were added to must in full fermentation they would not stop the action of the yeast, but would simply diminish its rate, as in the experiments mentioned on page 45. Therefore, the larger the amount of yeast present the more sulfurous acid is needed to delay or check fermentation. The kind of yeast also influences the result. Some yeasts are much more sensitive to the action of the acid than others. Part of the good effect of a preliminary sulfuring of the must is that the true wine-yeast is more resistant to sulfurous acid than most of the other organisms present, and musts thus treated are therefore likely to undergo a purer fermentation. Yeasts may even be selected with a special resisting power, as in the process described on page 56.

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* "Progrès Agricole et Viticole," vol. 29, p. 225.

† Roos: "Industrie Vinicole Meridionale," p. 234.

The possibilities of cooling by the use of sulfurous acid are of course limited by the amount of possible loss of heat by radiation. In warm cellars, or in very hot weather, the temperature will run up too high in spite of sulfuring. The same is true of fermentations in large vats. The method is, therefore, of limited use, and while very effective in small cellars and cool climates is usually insufficient under other conditions.

In the south of France the white musts are always treated with the fumes of burning sulfur. The old method was to burn a certain quantity of sulfur in each cask before introducing the must. Now the must is usually passed through a "sulfurizer" and then pumped into the casks. In both methods there is great uncertainty as to how much sulfur fumes are absorbed. In the first method only a portion of the fumes are taken up by the must, the remainder being expelled with the air as it is forced out of the cask by the must. The difficulty is not so great, however, in practice as it seems *à priori*.

If a small quantity of sulfur is burned, nearly all the fumes are absorbed, while if a large quantity is burned, the greater part escapes. Practical tests, under ordinary cellar conditions, show that if all the sulfur possible is burned in a small cask, the must when introduced in the ordinary way through a hose will absorb about .1 per mil. of sulfurous acid. If only one seventh of this possible amount is used the must will absorb .05 per mil., or half as much. That is, if we burn 2.7 ounces of sulfur in a 100-gallon cask it will have only twice the effect of burning .4 ounce. The amount necessary for defecating the must or for moderating the heat of fermentation lies between these two extremes of .1 per mil. and .05 per mil., so that when the fermentations take place in small casks the rough guess of the cellarman as to the quantity of sulfur to burn is usually near enough for practical purposes. With large casks this is not always true, as the sulfur fumes are absorbed more completely. The absorption, however, is not complete enough, even in this case, to make the amount of sulfur burned a sufficient measure of the amount of sulfurous acid introduced into the must.

Many ingenious devices exist for causing the must to absorb all the sulfur fumes produced and so to make it possible to introduce an exact amount. These devices are of two types: In one, the must passes through an apparatus placed in the bunghole of the cask, so constructed that all the fumes coming out of the cask pass through the incoming must and are therefore absorbed. In the other, the cask is filled first and the sulfur fumes are then forced into the cask by means of a pump. Most of the devices of the first type are cumbersome, troublesome to put in place, and are little used. One of the simplest is the *Brise-jet* of Roos, shown in Figs. 5 and 6. By means of this simple device the incoming stream of must is thoroughly broken up into a spray, and tests show that only from 1% to 5% of the sulfur fumes escape. This is quite close enough for practice. It can not, of course, be used except where there is a manhole on the top of the cask. For casks with only a bunghole on top a long tube pierced with small holes may be adapted to the end of the hose, but the absorption is then not quite so complete.

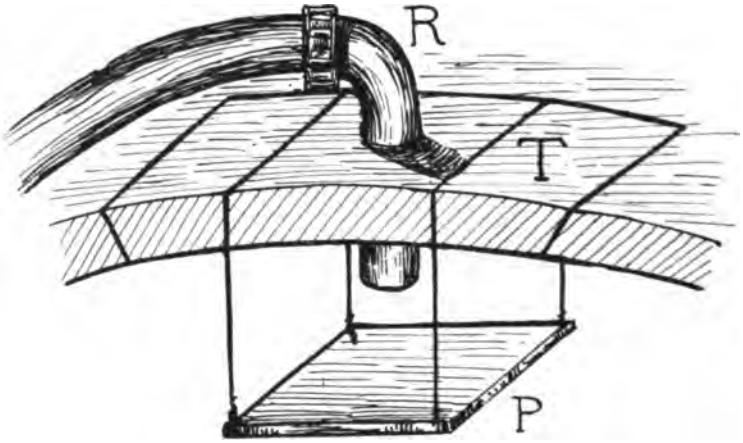

FIG. 5. Brise-jet.

R, hose for entrance of wine; T, cover of manhole to which is attached by cords a small piece of wood, P, on which the entering wine strikes and is broken up into a spray.

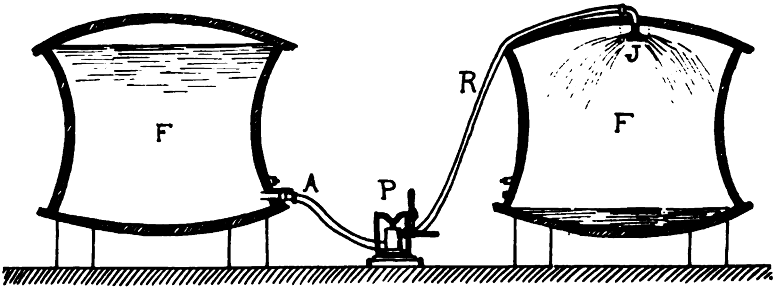

FIG. 6. Illustrates method of causing absorption of sulfur fumes by means of Brise-jet. F, cask containing wine or must to be sulfured; A, suction hose of pump, P; R, delivery hose conducting wine into cask, F, in which sulfur has been burned; J, Brise-jet.

The second type of sulfurizer is exemplified by Fig. 7. The correct amount of sulfur is weighed and placed in an iron pan beneath a cask from which one head has been removed. The suction hose of a pump is then attached to the bunghole of the inverted cask, and as the fumes are given off they are driven by the pump into the must, preferably through a hose inserted through the upper bunghole. This method is very effective for introducing large quantities of sulfurous acid, but is little used. The hot sulfur fumes are apt to injure the hose and pump and the method is troublesome to use in large cellars.

The sulfurizers used in most of the cellars which make large quantities of white wine are similar in principle to the one shown in Fig. 8. An examination of the figure (8) will make clear the principle of the machine. The must enters by the hose shown at the upper right-hand corner of the figure, flows from shelf to shelf through the sulfuring chamber into a reservoir below. The sulfur fumes generated in the stove shown at the lower right-hand corner of the figure enter the sulfuring chamber near the bottom and take a zigzag course to the top where the current of air which carries them escapes through a narrow chimney. This arrangement insures a thorough contact between the must and the sulfur fumes.

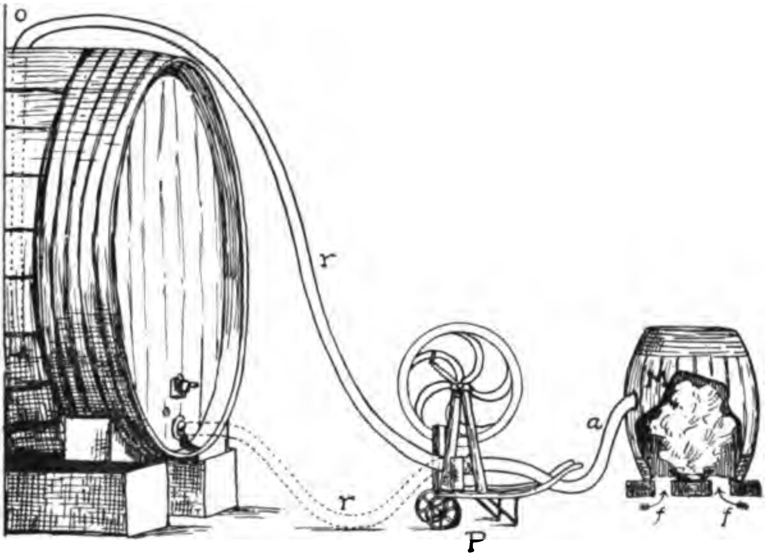

FIG. 7. Method of sulfuring must with a pump.

M, small cask with one head removed, serving as a chamber in which to burn the sulfur; *f*, *f*, openings for entrance of air: *a*, *r*, hose through which the sulfur fumes are forced into the cask of wine by means of the pump, P.

The sulfurous acid is so completely absorbed in this machine that there is no odor of burning sulfur at the opening O where the air escapes. The quantity of acid absorbed by the must depends on the amount of sulfur burned and the rate at which the must passes through the apparatus. It is possible thus to approximate a certain dose in sulfuring the must, but hardly more closely than by the old method of burning the sulfur in the casks. The chief merits of the machine are saving of labor and of the inconvenience and difficulty of burning sulfur in the casks, especially when they are large. At the cellar of Villeroy, near Cette, where 1,000,000 gallons of white wine are made annually, all the must is sulfured by two machines constructed on this principle.

Any of these methods can be effectively used in the manufacture of white wine where the dosing of the sulfurous acid has not to be done with a great deal of exactness. For red wine they are very imperfect, both because of the greater difficulty of introducing the fumes into the crushed grapes, and of the greater need for precision in the doses.

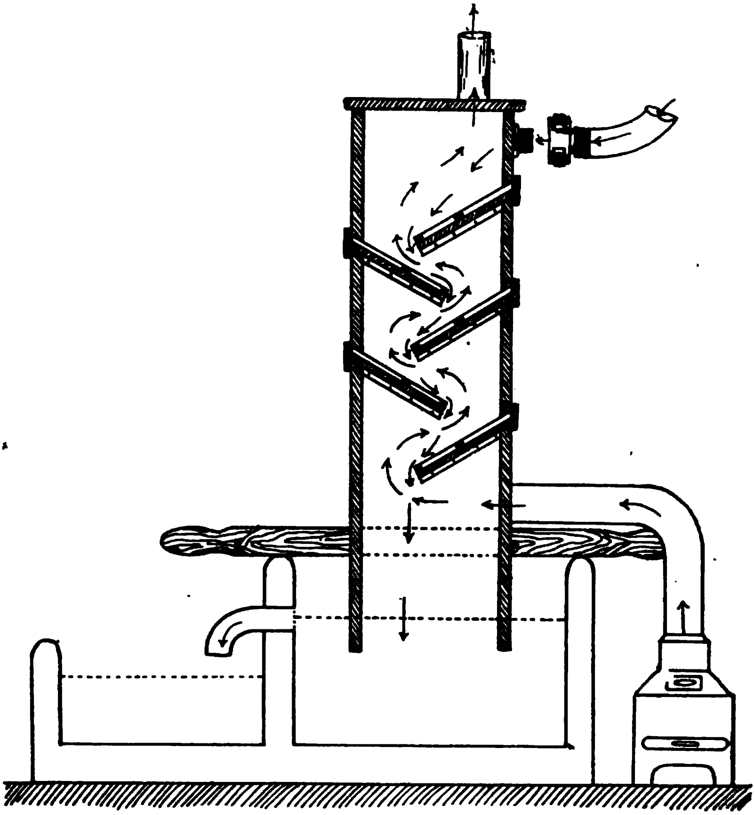

FIG. 8. Paul sulfurizer.

Sulfites.—Sulfurous acid has a strong bleaching action on many substances, and if used in red wine tends to decolorize it. This decolorizing may be very considerable if large quantities are used, as is shown by a test made by A. Bouffard.* Various amounts of the acid were added to a wine, and the loss noticed as follows:

Sulfurous Acid per mil.	Loss of Color.	Loss at One Month.
.025	7%	3%
.050	12%	6%
.075	25%	20%
.100	35%	30%

The second column shows the amount of color lost immediately after sulfuring when compared with the unsulfured wine. A month later the difference was much less, especially for the small doses. The loss is in any case, however, much less than appears at first. The color is not all destroyed and reappears to a great extent as the sulfurous acid disappears from the wine either by escaping into the air during racking or by becoming oxidized to sulfuric acid, or by forming various chemical combinations with substances in the wine. Moreover, the color which is left is more brilliant and more stable than that in an unsulfured wine. As there certainly is some loss, however, especially with large doses, it is necessary to use no more than is absolutely necessary to control the temperature. For this reason potassium meta-bisulfite is nearly always used in preference to burning sulfur when treating grapes and must for red wine.

The bisulfite is very easily soluble, and may be dissolved in a little water which is added to the grapes gradually as they are crushed, care being taken to distribute it well in all parts of the vat. To give a dose of .05 per mil. of sulfurous acid it would be necessary to add one-fifth of a pound of sulfite to every ton of grapes. This would cost about 6 or 7 cents. The sulfur necessary for the same dose would cost but a small fraction of a cent, but would be more troublesome and therefore costly to use, besides being less reliable.

POSTPONEMENT OF FERMENTATION UNTIL WINTER.

One of the great advantages that the vineyards of the high Little Atlas mountains and the elevated plateaus of Algeria have is that the weather is cool during the fermenting season. This is due partly to the elevation and partly to the late ripening of the grapes. If it were possible in the warmer parts to prevent fermentation of the grapes until cool weather, it would be comparatively easy to prevent hot fermentations. This can, in fact, be done by treating the crushed grapes with a sufficient quantity of sulfite. The amount necessary depends on the condition and composition of the grapes, the temperature of the cellar, and the amount of yeast present. Clean, acid grapes can be crushed and kept in a cool cellar for months by adding .5 mil. of sulfurous acid or two pounds of sulfite to every ton. Grapes with little acid or which have commenced to ferment, or which are kept in a warm place, would require more. The smaller amount, however, is sufficient to injure the color of red grapes considerably. While the method might be used for white grapes or must, it is not practicable for red grapes with the present arrangement of cellars, as it would necessitate a large increase of vats or other cooperage.

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*Bouffard, A.: "La Casse des Vins," p. 24. Montpellier, 1902.

FERMENTATION IN A COOL LOCALITY.

Large quantities of grapes, crushed grapes and must, are transported from the south of Europe to the north for wine-making purposes. This is not done, however, primarily for transferring them to a climate more favorable to fermentation. Grapes are sent from Italy and France into Germany for the purpose of supplementing the watery, acid, and badly ripened grapes of the latter country, and as part of the raw material of the innumerable vintages fabricated at Hamburg and elsewhere. Some of these grapes are transported in baskets, barrels, or vats as they are gathered, but the greater part are crushed before sending. When the distance is short no precautions are taken to prevent fermentation, but where the distance is over two or three days the crushed grapes and must are usually preserved with sulfurous acid. The amount used is about .4 per mil., or about 1½ pounds of sulfite to the ton. This is sufficient to paralyze all the yeast present and to prevent any danger of fermentation on the journey. Fresh must from sound grapes treated with this amount will usually keep for several months.

There is no doubt that if the grapes of the San Joaquin Valley could be transported to the Bay Region cheaply enough, there would be little more difficulty in fermenting them than the grapes of the coast valleys. This is proved by the wines made at the California Experiment Station cellar from grapes shipped from Tulare. It is simply a question of cost and shipping facilities. The extra freight charges would be considerable, as the weight of the grapes is about two-thirds greater than that of the wine they make. There would, besides, be the cost of boxes or other receptacles. In parts of Italy and Algeria crushed grapes are transported in specially constructed iron tanks on railway trucks. Sulfites could be used only for white wines, on account of the large amount necessary. In any case there would have to be sufficient guaranty that the grapes would not be more than two days from the time they were put on the truck to the time they were placed in the fermenting-vats.

In order to economize in freight charges many attempts were formerly made to concentrate the grapes or must before shipping. No advance seems to have been made, however, over the methods of Springhmühl, which were thoroughly tested in California, and those of Favara in Sicily. The method is fairly successful for the making of sweet wines, but these can be made as well or better in hot countries. For dry wines the concentrated grapes and must have failed, being little, if at all, better than dried grapes for this purpose.

CONTROL OF THE FERMENTATIVE AGENTS.

The various cooling devices just discussed act, in so far as they prevent imperfect or deleterious fermentations, by controlling the fermentative agents. That is, they keep the fermenting mass at a temperature favorable to the true wine-yeast whose action we want to assist, and less favorable to the bacteria and other injurious organisms whose action we want to hinder. Cooling, however, only *hinders* the growth of the latter, but in no case *completely prevents* it. Under favorable conditions this action is so slight as to be practically inappreciable; under less favorable conditions the freshness and bouquet of the wine may be impaired, or in extreme cases the wine spoiled. These are, however, only differences in degree. If we could find some means of absolutely excluding all organisms from the must except the true wine-yeast, we should get none of the defects due to injurious secondary fermentations under any conditions.

Pure Yeasts.—With this object in view various methods have been devised for sterilizing the grapes and must; that is, of freeing them from all micro-organisms of any kind, and subsequently fermenting them by adding a pure yeast. A pure yeast is a liquid containing no micro-organisms but yeast cells and only one kind of yeast cell. For about twenty years, extensive laboratory and practical tests have been made with these methods, but there is still wide divergence of opinion as to their merits. There is perfect unanimity of opinion as to the value of eliminating unfavorable organisms, but on the value of the use of pure yeast there is much difference of opinion. On one side it is claimed that the character of Château Iquem or of Clos Vougeot may be given to the wine from any grape, or even from apples, wherever grown, by the use of a pure yeast selected from the vineyards which produce these famous wines. Factories are in existence which are ready to supply yeasts from any one of the hundreds or thousands of famous wines of the world, with the implied assurance that they will enable any winemaker to produce these famous wines anywhere. Much of this is no doubt due to the exaggeration inseparable from advertising. The claims of certain laboratory investigators of pure yeasts, however, fall little short of those of the vendors of pure yeast for wine-making, and are undoubtedly in many cases excessive and misleading. At all events they are not substantiated by results in practice, or by the work of other investigators. On the other hand, it is an equally great mistake to suppose that the purity or selection of the yeast has no effect on the wine. The comparative purity of the yeast is the object of a great part of the care taken wherever good wines are made, and there is no doubt about the great differences which exist in different yeasts and in their effects on the wine.

It is just here that there is danger in the use of absolutely pure yeasts prepared by modern methods. While it may not be possible to make the difference between a "Rommanée Conti" and a "Château Lafitte" wine by a proper selection of yeasts, there can be no doubt whatever that it is possible to make the difference between a good wine and a bad wine from the same material according as we use an appropriate yeast or an inappropriate one. We can not make good wine from *any* grapes by the use of pure beer-yeast, bread-yeast, or any of the hundreds of yeasts which we can find almost anywhere. Moreover, it is quite possible to select from grapes pure yeasts which have very different effects on the wine in fermentation. Some pure wine-yeasts will not give good results at high temperatures, others at low; some will not cause the fermentation of more than 18% of sugar, others can ferment 26% and so on. If, therefore, we use *pure yeasts* we must use *selected pure yeasts;* yeast selected and tested for the particular purpose in hand.

Most of the pure yeasts distributed in Germany and France have been properly selected, and in spite of the exaggerated claims of the makers, usually give good results when properly used. It would, however, be quite possible to completely spoil wine by the use of a pure yeast not properly selected for the particular must in which it is placed. This is no doubt the reason why pure yeasts obtained from the regions where they are to be used have nearly always given better results than yeast imported from other regions. It is far more likely that a pure yeast separated from fermenting Fresno grapes will prove resistant to high temperatures and capable of fermenting very sweet must, than one separated from grapes grown on the Rhine. The yeasts which exist in any region have undoubtedly been subjected for ages to a process of natural selection which has fitted them for the conditions of that region. Rhine yeast will, therefore, not help us to make Rhine wine in Napa County, unless we can get grapes whose composition approaches those of the Rhine, and can imitate the temperature and other conditions usual in the Rheingau.*

To obtain the best results from the use of selected yeasts in promoting a thorough fermentation or improving the wine in any other way, a more or less complete sterilization of the grapes or must is necessary. Very numerous trials have been made, with this object in view, during the last twenty years. While the question of the degree of improvement to be attained by the use of selected yeast is not yet settled, the attempts at sterilization have brought to light some unforeseen but very important facts regarding the effect of the methods used in the process of wine-making.

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*See, for a good practical example of this:—Report of Viticultural Work, College of Agriculture, Berkeley, 1887–93, pp. 400–402.

Attempts have been made to free must from fermentative organisms in various ways; but only two, so far, have given good results or been adopted in practice. These are sterilization by heat and sterilization with sulfurous acid.

Twenty years ago Louis Marx and others attempted to sterilize musts by heat for the purpose of fermenting them with pure yeast. The results, while promising, were not completely successful, on account of the cooked and "rancio" taste of the wines made. These tastes were due to the imperfect appliances with which the experiments were made. Later, Rosenstiehl, starting from the known facts, that the cooked or raisin taste was due to heating the must too high and the consequent caramelization of a portion of the sugar, and the "rancio" taste due to the exposure of the hot must to the oxygen of the air, invented and patented a process of sterilizing the must at a low temperature and out of contact with the air. The first defect was remedied by heating the must three times to a comparatively low temperature, allowing an interval to elapse between successive heatings. This had the effect of killing all germs in the must as effectively as a single heating to a higher temperature. The second defect was avoided by keeping the must in an atmosphere of carbonic acid gas during the heating.

Rosenstiehl's method, while effective, was slow, and required complicated and expensive machinery. Later it was shown, principally by the researches of Kayser and Barba at Nîmes, that the object which Marx and Rosenstiehl had in view, the absolute sterilization of the must, is not necessary in ordinary wine-making; and further, that the absolute exclusion of the air during heating, which Rosenstiehl attempted, is also unnecessary. All that is necessary in the first respect is that the must shall be "pasteurized"; that is, heated to such an extent that all *active* germs are killed. If a few germs in the latent or spore condition are left, they are absolutely innocuous, as they can not develop in time to do any harm. Before they have multiplied sufficiently, the wine is made and safe from their attacks. It is possible, therefore, to eliminate the injurious germs sufficiently by one heating to a temperature too low to caramelize any sugar.

With regard to the "rancio," it was found that must or grapes could be heated as high as necessary without acquiring this taste, if the exposure to the air was not excessive or continued for too long. It has lately been found possible, by the addition of a little sulfite before heating, to almost do away completely with any danger of oxidation, even with considerable contact with the air, and at the same time to get a more complete sterilization at a comparatively low temperature.

Sulfiting.—A method which promises well for use in hot climates is one devised by Martinand and Andrieu. It consists of adding a certain amount of bisulfite of potash to the crushed grapes and the subsequent addition of selected yeast. The addition of the sulfite is sometimes spoken of as a "sterilization." It is doubtful if the amounts used are sufficient to actually kill all germs in the must, but they are sufficient to prevent them from developing for some time; and in the meanwhile the selected yeast has time to completely take possession and finish the fermentation.

There are three ways of applying this method. The first is to add sulfite to the fermenting grapes in two or three doses, and is practically identical with the method already described (see page 46) for moderating the temperature by the same means. The other two methods differ in that so much sulfite is used that ordinary yeast is paralyzed with the other germs. For this reason it is necessary to have a special yeast which is capable of acting in the presence of the amount of sulfurous acid introduced into the wine. Such a special yeast is procured by taking any good strong yeast and gradually accustoming it to grow in the presence of large amounts of sulfurous acid. This is done in one of two ways. The way recommended by Andrieu is to fill each of two 50-gallon casks one-third full of must sterilized by heating. In the must in one cask is dissolved .5 per mil. of potassium meta-bisulfite; that is, 1 ounce to 15 gallons. The must in the other is started fermenting by introducing a small flask full of pure yeast. As soon as the must in the second cask is fermenting well, 5 gallons of the sulfited must from the first cask is poured in. This will check fermentation temporarily, but in a few hours the yeast becomes accustomed to the sulfurous acid and fermentation commences again. As soon as fermentation is well reëstablished another 5 gallons is added; and a few hours later the remainder of the sulfited must. When the yeast is fermenting well after the last addition of sulfite, it is ready to be used on a vat of grapes. The grapes as they come from the crusher are sulfited with a dose of potassium meta-bisulfite equal to that to which the yeast has become accustomed, *i. e.*, .25 per mil., or 2 pounds to 1,000 gallons or 4 tons. This is sufficient to prevent all fermentation except that of the added yeast. A pure fermentation is thus assured.

The other method is to train the yeast in the fermenting-vat itself. This is done by adding a pure yeast to the grapes as they pass into the vat, together with one-third of the amount of sulfite which is to be used, *i. e.*, two-thirds of a pound to the 1,000 gallons. This is enough to retard but not to prevent fermentation. As soon as fermentation has well started, another third of the sulfite is added, and then the remainder when renewed fermentation shows that the effect of the second dose has been overcome.

All these methods have given excellent results in numerous cases, but the second and third, and especially the second, are much more effective than the first.

SUMMARY.

METHODS ADOPTED IN SOUTHERN FRANCE AND ALGERIA.

Modern wine-making in these regions has developed along different lines, and each region has adopted a different method of overcoming the difficulties connected with the making of dry wine in a hot climate.

In southern France these difficulties have been attacked principally by means which aim at making the raw material more amenable to the conditions and methods of manufacture which exist there. The successful production of dry wines, there, depends in a large measure on: (1) the planting of the Aramon, a vine which produces grapes of high acidity and low sugar; and (2) on the gathering of all varieties before they are perfectly ripe. While the trouble of incomplete fermentations are thus, to a great extent, avoided and a sound wine generally made, the result is not altogether satisfactory. During the epoch immediately following the destruction of most of the vineyards by phylloxera (1890–1899), the abundant crops of thin, watery wine were very profitable. Now, when the supply has caught up to or passed the demand, the price obtained for the wine is often below the cost of production. A very large proportion of the Aramon wines can not be marketed without blending with heavier wines, and in years when the crop is large the price falls very low. In 1904 large cellars sold their crops at less than 6 cents per gallon, and the average price was probably not much over that figure. The wine has to be blended with Algerian or Spanish wines, and the wine-merchant can afford to give but little more for it than for piquettes and sugar wines.

In Algeria the Southern French method could not be applied. There, even the Aramon often attains too much sugar to ferment out completely without aid, and the grapes ripen so rapidly in the hot autumn that it is impossible to gather them all before they are quite ripe. Moreover, in the hot weather which is often experienced during the wine-making season in Algeria, grapes, even with low sugar-content and high acidity, may fail to complete their fermentation. Even if the Southern French method were possible, it would be impracticable in Algeria, where it would always be unprofitable to produce light blending wines in competition with the Midi. The demand for Algerian wines is based on their capability of correcting the defects of the Midi wines, and, to retain their market, they must be alcoholic and rich in tannin, color, and extract. Some means, therefore, had to be found which would enable the wine-makers to ferment Alicante Bouschet, Carignane, and similar grapes with 22% to 26% of sugar. The only method which has come into general use is that of keeping down the temperature with cooling machines. This, as already noted, has enabled them to produce sound, alcoholic wines, but the moderation of the temperature has entailed a loss in the valuable qualities of deep color and high extract. In neither France nor Algeria, then, are the present methods of manufacture completely satisfactory, and attempts at improvement are being made along all the lines discussed in this report.

On the whole, however, there is less loss from spoiled wine there than with us, and a consideration of the methods of French and Algerian wine-makers offers many suggestions of possible improvements in our own methods. In no region, however, are the markets, raw materials, and conditions of manufacture identical with ours, and we can not, therefore, copy exactly any methods however successful elsewhere. It is impossible, moreover, to point out any method or group of methods that can be adopted here with absolute certainty of success in all regions. It is possible, however, to point out certain methods which, if adopted, will certainly result in great improvement in many of our wines. The conditions of soil, climate and grape varieties in Algeria resemble ours much more than do those of southern France. The following short description of the most approved method of vinification in Algeria should be of interest. It was kindly furnished me by Dr. Roger Marès of Algiers, who is an expert authority on the subject:

WINE-MAKING IN ALGERIA.

At the beginning of the vintage the juice of some well-washed grapes is placed in a small, perfectly clean and sterilized cask, and the contents of a flask of pure selected yeast added. The cask is placed in a clean room where there is no danger of infection by bad germs from cellar, fermenting-room, or pomace heaps. The room is kept at a favorable temperature (65° to 75° F.).

When the must is in violent fermentation it is added little by little to the vat as it is being filled with crushed grapes. If the temperature of the grapes is between 77° and 86° F., fermentation commences immediately.

The fermenting grapes are stirred frequently, night and day, and the temperature watched. The fermenting must is cooled as soon as it rises to 97° or 100° F. The temperature should not be lowered below 86° F.

The wine should be perfectly dry in a few days.

Fermentation takes place in open vats not deeper than 5 feet 6 inches. It is best not to have them exceed 11 feet in diameter, or the workmen find it difficult to stir them from the sides. If made wider a plank is placed across the middle to support the workmen while stirring.

The vats are made of masonry covered with cement, and cost about 2 cents per gallon.

It is always best to have the fermenting-room about 100 feet from the storage cellar; with this arrangement fermentation takes place better in the vats and the wine keeps better in the cellar. The cellar should be placed on the windward side of the fermenting-room.

Deep fermenting-vats are no longer built, and where they exist they are only partially filled.

Pressing is usually done with screw presses, but occasionally continuous presses are used, especially before fermentation when white wine is made.

Stemming is generally practiced, but if the grapes are clean and sound only a part of the stems is removed.

The pressed pomace is used for the production of piquette by the sprinkling method. The extraction of the wine from the pomace by the Roos method of displacement is advisable, but has not yet come into practice.

Selected yeasts are used only for the first vats; for the following vats about fifty gallons of fermenting must is taken from a previously filled vat and added gradually as the crushed grapes come from the crusher.

This may be considered the most approved method of wine-making at present in use in Algeria. It differs from the method in most general use principally in the character of the fermenting-vats. The use of low, open vats and a separate fermenting-room necessitates an outlay which most Algerian wine-makers avoid by fermenting in the "amphoras" in which the wine is stored. These amphoras are constructed of masonry, concrete or brick, usually lined with glass. They resemble in shape

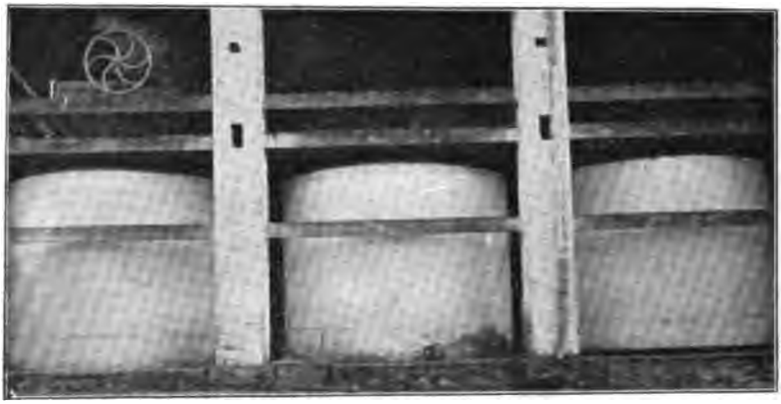

FIG. 9. Algerian amphoras used for fermentation.

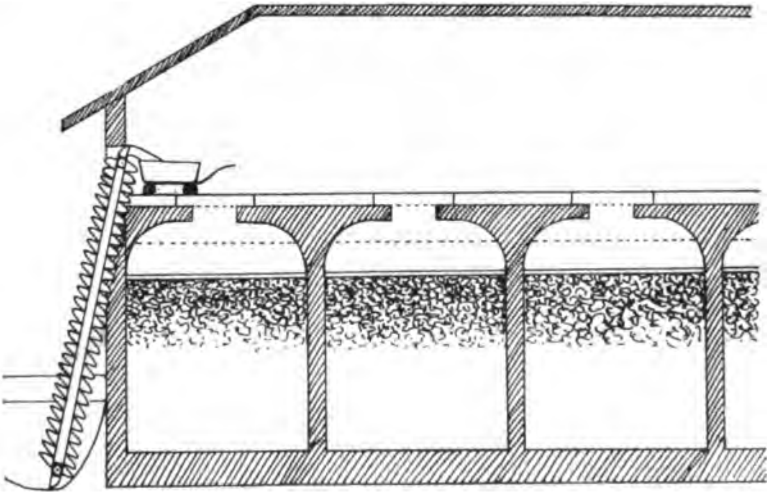

FIG. 10. Cross-section of an improved arrangement of amphoras for fermentation and storing.

huge bottles, and hold from 1,200 to 12,000 gallons each. The diminution in the amount of spoiled wine in Algeria is undoubtedly due in some measure to the use of these amphoras, which it is possible to clean and sterilize with the greatest ease. They have many advantages over wooden casks or vats, especially for the handling of young wines. They can be cleaned in a few minutes simply by washing with a hose, and require no care when empty, as they do not shrink or become moldy, like wooden cooperage. There is no evaporation of the wine when they are filled, so that there is no loss of volume in keeping the wine, as with oak and redwood casks. They utilize the space in a cellar better, as they can be made of almost any shape and enable the wine-maker to store a much larger volume of wine under a given roof. In Algeria they have the further advantage of being considerably cheaper than oak casks. Their only defect is that they prevent the aging of the wine. This is, however, in Algeria an advantage, as the wine-buyers prefer a young, well-defecated wine which they can transport to France and age in cool cellars. The cost of these amphoras in Algeria ranges from 2 to 4 cents per gallon, depending on their size, shape, kind and amount of glazing, and the cost of transporting the material.

In comparing the relative cost of amphoras, oak casks, and upright vats, account must be taken of the differences in space occupied. Wine stored in round oak casks of 3,000 gallons capacity requires about 40 square feet of floor space for every 1,000 gallons. If stored in upright vats holding 10,000 gallons, of the form of the redwood vats commonly used in California, about 30 square feet is required per 1,000 gallons. With amphoras of 10,000 gallons capacity, 1,000 gallons can be stored in every 20 square feet. In other words, a cellar of one story with a floor space of 100 by 100 feet will hold about 250,000 gallons of wine in 3,000-gallon oak casks, 350,000 gallons in 10,000-gallon redwood vats, and 500,000 gallons in 10,000-gallon amphoras.

The cleanliness of the Algerian cellars visited was remarkable, and in strong contrast to many of the large cellars of southern France. The absence of woodwork and the liberal use of concrete make the work of keeping the cellars clean comparatively easy, as do also the simple and effective devices for handling grapes and pomace used by most wine-makers. The ease with which bacterial infection passes from cask to cask and from one vintage to another in hot climates has taught the Algerian wine-maker the necessity of thorough and frequent sterilization of everything with which the grapes or wine come in contact. Concrete vats and amphoras, if suspected, are rapidly and easily sterilized by swabbing with a 5% solution of sulfuric acid, but usually a simple washing with water is quite sufficient to keep them in good condition.

For the sterilization of wooden casks and vats of all sizes small steam generators of a special form are much used both in France and Algeria, and are very effective. They are portable and so constructed that they produce dry steam superheated to over 500° F. under little or no pressure. They are useful in large as well as in small cellars, even where a steam boiler exists for other purposes. It is a great advantage to be able to sterilize casks at any time, and one of these small cask steamers can be heated up and used much more easily and rapidly than an ordinary steam boiler. They also have the advantage that they can not

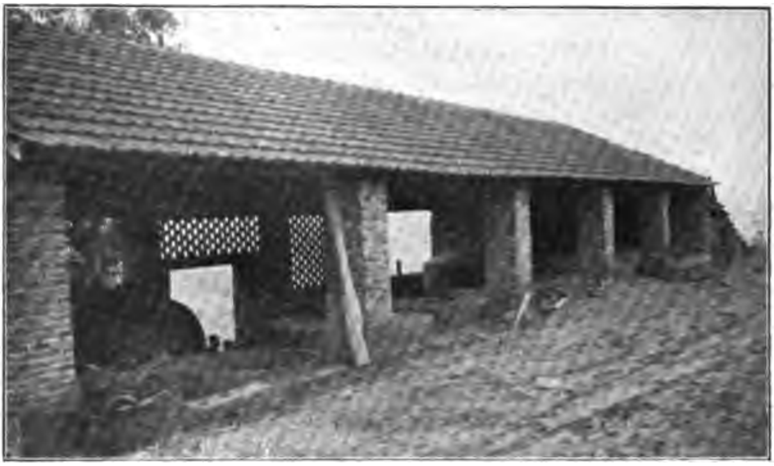

FIG. 11. Medium-sized wine-cellar and fermenting-room.

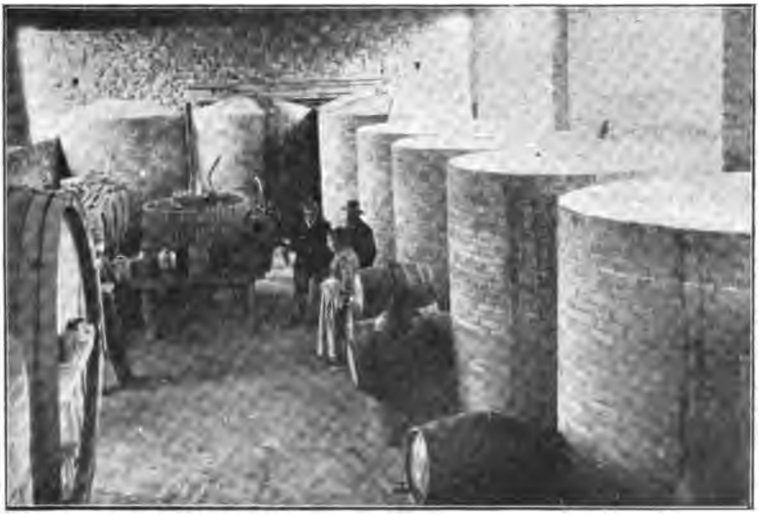

FIG. 12. Inside view of same cellar shown in Fig. 11.

explode, and the superheated dry steam they produce is much more effective in penetrating and sterilizing power than the pressure steam from an engine boiler.

Wherever separate fermenting-vats are used the tendency is to place them in a building separate from the storage cellar. This building is usually made very open, in fact is often simply a shed with open sides.

The figure on the cover of this bulletin shows the simple installation of a wine-maker near Berrouaghia, which may be taken as typical of small-scale wine-making in Algeria. It consists of an open shed covering three rectangular stone vats. The grapes are crushed into these vats and, after fermentation, are stored in the same vats, which are then covered with heads made air-tight with clay or plaster. The arrangement seems very primitive, but for the purpose is both cheap and effective. The small open vats are cooled off at night, so that only when the sirocco blows is there much danger of a hot fermentation. The wine is usually sold and shipped at the first racking, so that it is not exposed to the hot weather of the summer following the vintage.

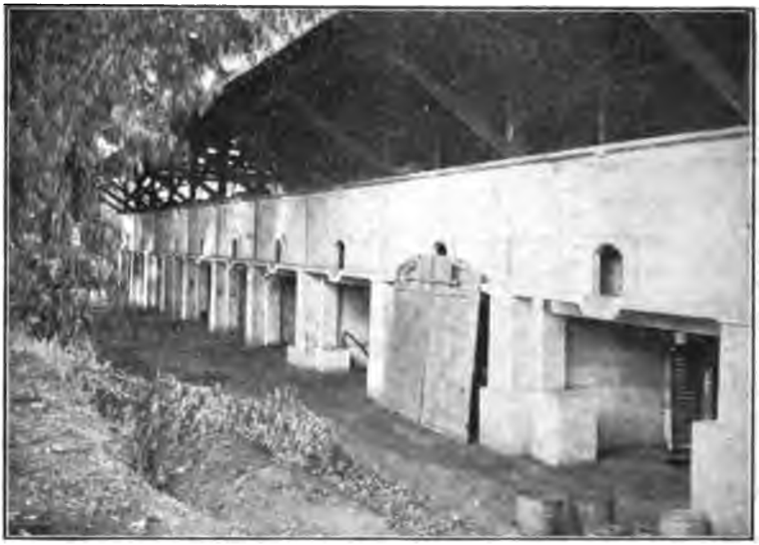

FIG. 13. Open fermenting-room and shallow fermenting-vats of large cellar in the Sahel.

Figs. 11 and 12 show a good example of a medium-sized cellar where from 10,000 to 20,000 gallons of wine are made. The sides of the cellar, which is for both fermenting and storing, are very open. The fermentation takes place in open brick vats and the wine is stored in brick amphoras. This cellar is in the Miliana region at a high elevation. The vintage is late and the weather not usually very hot during wine-making. The soil, the vineyards, and the wine in this district recall those of

Howell Mountain and similar situations in California. No cooling machines are used in either of these cellars.

Fig. 13 shows a good example of a fermenting-room of a large cellar in the "Sahel," the low range of hills running along the coast west of Algiers. Here the grapes become very sweet, ripen early, and the weather during the vintage is usually hot. The fermenting-vats are shallow, raised about 5 feet from the ground, and placed under an open shed. They are made of armed cement and have walls only about 4 or 5 inches thick. The method of wine-making is practically that advocated by Professor Marès, described on page 58. Cooling machines are used and every effort made to keep the temperature of fermentation low. As water is both scarce and warm, two cooling towers have been built to reduce the temperature of the water for the cooling machines. Fig. 14 shows one of these towers with the large fan used to produce the current of air necessary to cool the water.

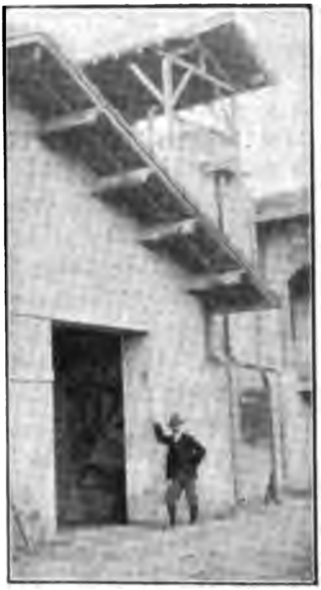

FIG. 14. Cooling tower. Used in connection with fermenting cellar shown in Fig. 13.

CONCLUSIONS.

The main lesson of immediate practical importance to California wine-makers to be learned from these observations and experiments is the oft-repeated one of *cool fermentation.* It seems strange that in Algeria, where cool water is far more scarce than in California, the wine-makers should have been able to make the use of cooling machines a practical success, while here little or no progress has been made in that direction. The reason is to be found probably in a lack of a real appreciation of the need and use of cool fermentation among the wine-makers of the regions where dry wines are usually made, and of the difficulty of applying known methods in the hotter regions, where the cellars are nearly all of great size.

With regard to the first there is undoubtedly a very general lack of realization of the benefits to be derived from fermenting wines at a low temperature. A wine which attains a temperature of 95° to 100° F. during fermentation will never have the freshness, bouquet and general high quality of one which never exceeds 85° or 90° F. Even though the former ferments out completely and remains a perfectly sound wine, its quality and especially its bouquet is injured, and the headiness of many California wines, and of wines from other hot countries, is undoubtedly due in great part to the high temperature of fermentation. The greater intoxicating effect of a California wine with 13% of alcohol over a Château Margaux with 11% can not be all ascribed to the slight difference of alcoholic strength. The variability of even the best brands of our California bottled wines is also in great part due to the lack of a more perfect control of the fermenting temperature. The California wines which a traveler finds in the Eastern States and in the hotels and dining-cars of England and the Continent are undoubtedly much superior to those he would have found there five or ten years ago, but they are still often very disappointing to one who knows how good they can be sometimes. The first step to be taken in establishing uniform and reliable brands of fine California wines is for the wine-makers to give their wines the uniform good quality which can only be obtained by fermenting every vat at a uniform and low temperature. This will render the work of the wine-blenders and handlers comparatively easy.

With regard to the production of common or bulk wines the problem is somewhat different. Here the main object is to produce a sound wine of good keeping qualities as cheaply as possible. The finer qualities of bouquet, freshness, and lack of headiness are of less importance. One of the essentials of cheapness is the production of heavy crops. Our cheap wines must be made, then, from heavy-bearing varieties of vines planted in rich soil. The vineyards of southern France, where common wines are made, produce from 8 to 10 tons per acre, and even as much as 12 to 15 tons as the average for whole vineyards. The vineyards of the Metidja Plain in Algeria produce as much. There are immense tracts of land in the Sacramento and San Joaquin valleys which are capable of producing equally large crops. The question is, can these crops be turned into good, sound, dry, red wines.

Innumerable tests at the California Experiment Station cellar prove that good, sound, dry wines can be made from grapes grown in rich, irrigated and alkaline soil in Fresno and Tulare. The experiments detailed on page 25 even show that wines of high quality can be made from such grapes. There is nothing, therefore, in the nature of the grapes themselves which will prevent the manufacture of good, dry wines in the great central plain of California. It remains to be seen whether a practicable method of wine-making can be devised which will overcome the difficulties which have so far prevented the production of such wines there.

The most promising direction in which to look for such a method is at present in line with the experiments of Barba, and the Berkeley Experiment Station. The method in short that offers an almost practical certainty of attaining our object is the following:—

1. Heating the crushed grapes to a temperature and for a time sufficient to extract the necessary color, tannin, and body.
2. Immediate separation of the must and cooling to 85° F.
3. Immediate fermentation of the must at a temperature not exceeding 90° F.

This is not to be understood as a recommendation of this method for immediate introduction into any cellar. The present status of the method is this:

1. It has been shown, both in California and in France, that it is possible, when working with small quantities, to attain the object in view by this method.
2. The method has been used with success in France in the whole output of a cellar manufacturing 75,000 gallons of wine in a season.

It remains now to be seen whether the method can be made practicable for California conditions. A careful study of these conditions has left little doubt in my mind that it can, and the failure of all other methods that have been tested so far makes it very desirable that it should be given a thorough trial. There are numerous details of the method which have to be carefully investigated, but none of them offer any apparently insuperable difficulties.

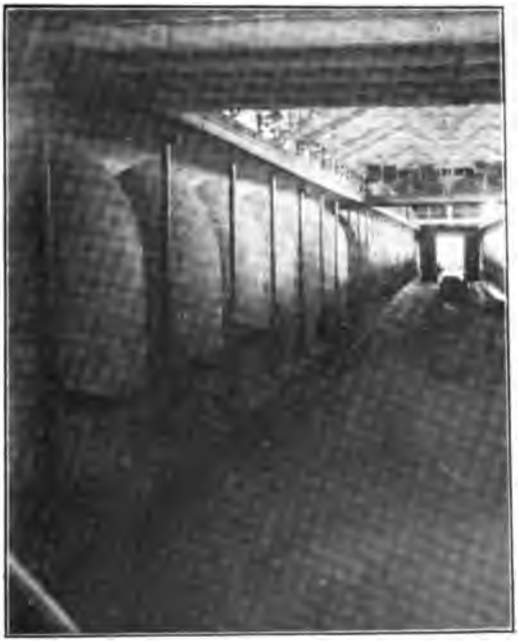

FIG. 15. Brick amphoras in a large cellar in Algeria.
This form is being abandoned, on account of the difficulty of making the vats strong enough when large.

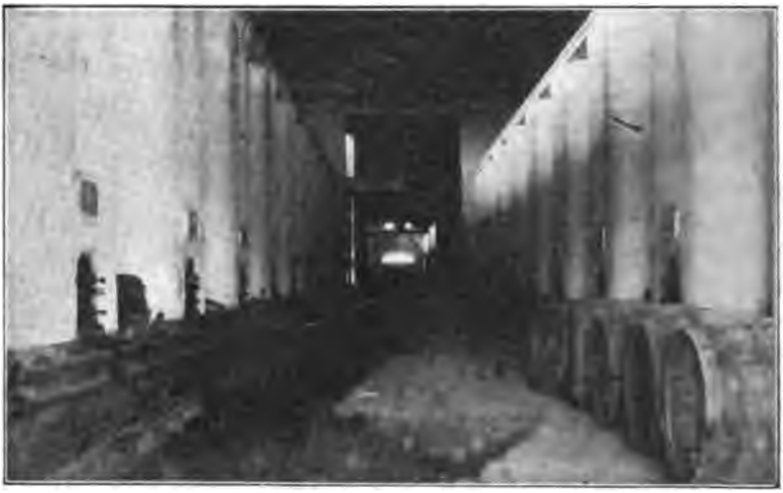

FIG. 16. Amphoras in one of the largest and most modern cellars in Algeria.

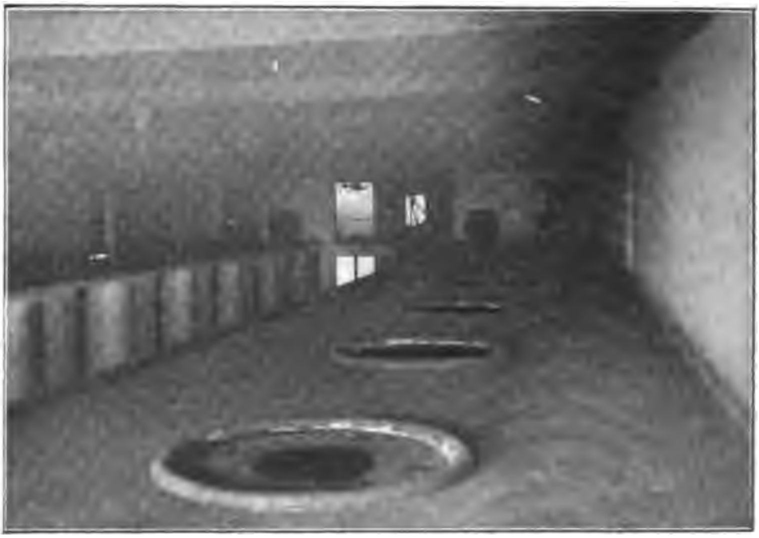

FIG 17. Top view of the amphoras shown in Fig. 16.

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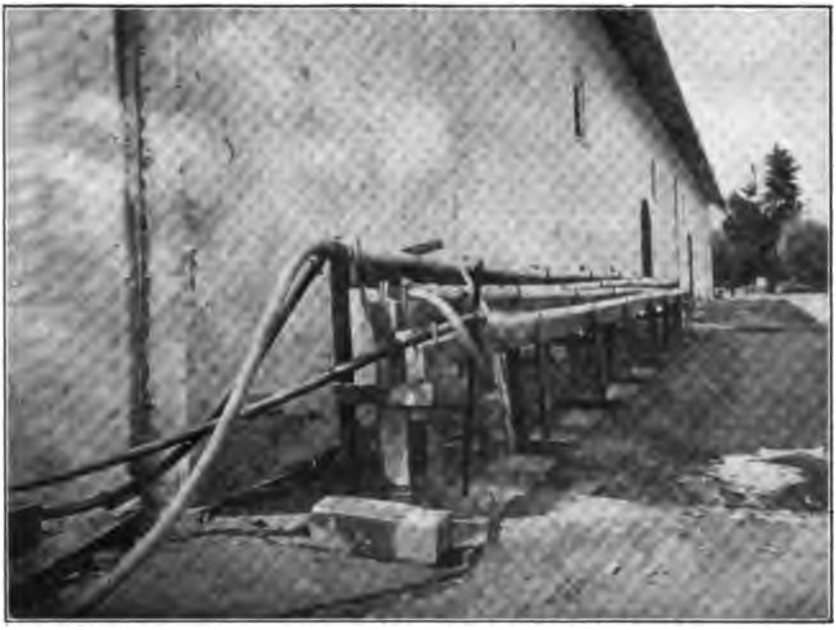
AGRICULTURAL EXPERIMENT STATION.

A NEW WINE-COOLING MACHINE.

By FREDERIC T. BIOLETTI.



BULLETIN No. 174.

(Berkeley, January 4, 1906.)

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A NEW WINE-COOLING MACHINE.

In planning for the series of wine-making experiments which will be detailed in Bulletin No. 177, it was necessary to devise a cooling machine, both for the reduction of temperature of the heated must and for the control of the temperature of fermentation. While the machine made was intended only for a temporary and special purpose, it proved so efficient, and is at the same time so simple in construction and of such moderate cost, that it will be found useful in nearly all wineries where any attempt is made to keep the temperature of the fermenting wine within the most favorable limits. For this reason the construction and work of the cooler are described here, together with some of the preliminary tests made with small models before the full-sized machine was constructed.

Description of the Cooler.—The machine consists essentially of a copper tube 220 feet long and 1¼ inches in diameter, through which the wine is pumped and which is inclosed in a canvas irrigating hose 4 inches in diameter, through which cold water runs in a direction opposite to that of the wine. The whole is supported on a wooden stand, as shown in the figure on the cover of this bulletin where the cooler is shown in operation.

Capacity of the Cooler.—The capacity (that is to say, the amount of wine which can be cooled in a given time) of any cooler of this type will depend on the number of degrees which the wine is lowered and on the difference of temperature between the wine and the water. The tests shown in Table I indicate that 1,000 gallons of must at 140° F. can be lowered 50° F. (viz., to 90° F.) per hour by the use of 1,100 gallons of water at 71.5° F. (see test 8). If the hot must has a temperature of 125° F., the same amount will be lowered by the same amount of water of the same temperature 41° F., or to 84° F. (see test 9). As fermenting wine never attains such high temperatures as these, test 10 is interesting as indicating what can be expected from the machine in controlling the temperature of a fermenting vat. This test shows that 1,000 gallons of fermenting wine can be lowered from 95° F. to 78° F. (viz., 17° F.) in one hour by the use of 850 gallons of water at 71.5° F.

Comparison with Other Coolers.—In order to compare the work of this cooler with coolers of other forms, a factor was calculated representing the number of gallons of wine cooled per hour 1° F. per unit of surface, and for one degree of reduction of temperature of the wine, and for one degree of difference between the temperature of the hot wine and of the cool water.

Given:

R = Number of gallons of wine cooled per hour.
F = Number of degrees Fahrenheit wine is lowered.
D = Number of degrees of difference between the temperature of the hot wine and of the cool water.
S = Number of square feet of surface of cooling tube.
K = Number of gallons per hour cooled 1° F. per square foot of S and per each degree of F and each degree of D.

Then,

$$K = \frac{R \times F}{D \times S}$$

This factor K will doubtless vary considerably according to whether we are dealing with liquids very near together or very far apart in temperature, or if we pass very small or very large volumes of wine through the machine; but within the limits of practice, it was found very constant and gives a very simple and accurate measure of comparison between different machines and different ways of using the same machine. For purposes of comparison, observations were made on two other wine-cooling devices. One of these devices consisted of a length of iron water-pipe placed in an irrigation ditch, and was used for cooling sherry in taking it from the heating house to the storage cellar. The piping consisted of 400 feet of 1-inch and 200 feet of 1½-inch iron water-pipe, through which the wine was pumped. The test of this device is shown under No. 11 in Table I.

TABLE I.

Tests of Cooling Machines.

Test.		WATER.			WINE.			R	F	D	K	S
		Rate.	1st Temp.	2d Temp.	Rate.	1st Temp.	2d Temp.					
1	End closed	450	71.0	91.0	550	99.0	79.0	550	20.0	28.0	5.46	72
2		750	71.0	82.0	550	94.0	76.0	550	18.0	23.0	5.98	72
3		750	71.0	81.0	550	92.0	75.0	550	17.0	21.0	6.18	72
4	End open; much leakage	900	68.0	109.0	900	117.0	91.0	900	26.0	49.0	5.27	72
5		900	68.0	98.0	1,000	102.0	84.0	1,000	18.0	34.0	7.35	72
6		900	68.0	92.0	900	95.0	82.0	900	13.0	27.0	6.02	72
7		900	68.0	......	900	82.0	77.0	900	5.0	14.0	4.46	72
8	End open; little leakage	1,100	71.5	114.0	1,000	139.0	89.5	1,000	49.5	67.5	10.19	72
9		1,100	71.5	106.5	1,000	127.0	86.0	1,000	41.0	55.5	10.26	72
10		850	71.5	88.0	1,000	97.0	79.5	1,000	17.5	25.5	9.53	72
11	Sherry C.	......	82.0	......	1,500	120.0	93.5	1,000	26.5	38.0	5.68	184
12	U. C.	500	72.0	......	2,400	101.0	88.0	2,400	13.0	29.0	5.75	187

R = Number of gallons cooled per hour.
F = Number of degrees F. wine is lowered.
D = Difference between temperature of hot wine and cool water.
K = Gallons per hour cooled one degree per square foot, and degree, etc.
S = Number of square feet of surface of cooling tube.

The other device consisted of an ordinary beer wort cooler, but the wine instead of flowing over the outside was pumped through the tube and cooled by allowing the water to drip over the outside of the battery of tubes. The cooling was made more complete by the use of two propeller fans, which caused a strong current of air to pass over the surface of the tubes and cool the water by evaporation. The test of this machine is shown under No. 12 in Table I, where it is indicated by the letters U. C., meaning "University Cooler," as it is identical in principle with the cooling machine invented at the Berkeley Experiment Station, and described in Bulletin No. 117. (See Figs. 1 and 2.) The first of these machines is useful for the purpose intended, and requires little attention, but would be of little use in controlling the temperature of fermentation, owing to the high temperature of the water in the irrigating ditch during the vintage. Moreover, by comparing the factor K in test 11 with that of test 9, it will be seen that for unity of surface it is little more than half as efficient as the machine used in our experiments, notwithstanding the fact that it was supplied with a practically unlimited amount of cooling water.

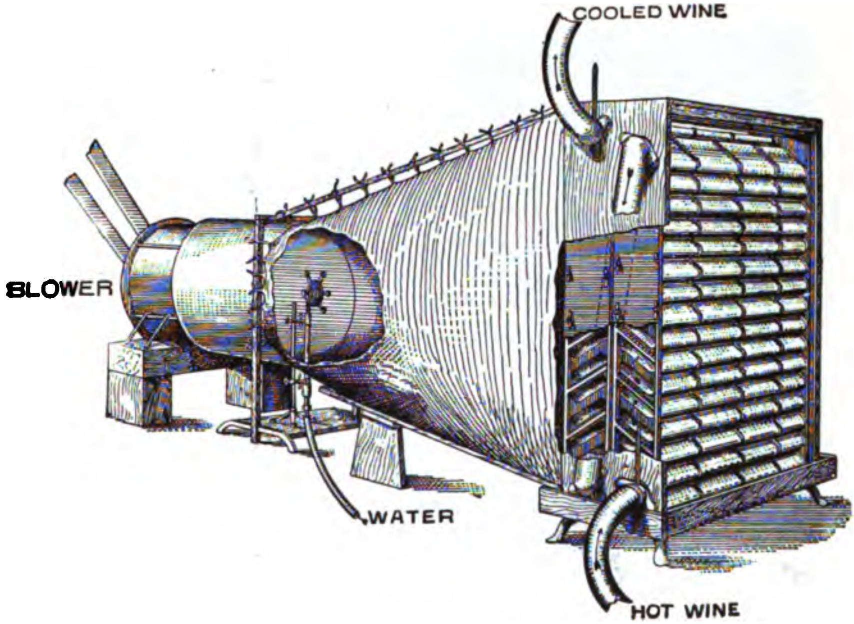

FIG. 1. University air-blast cooler.

The efficiency of the U. C. machine, as indicated by the factor K of test 12, is little larger. The principal merit of this machine is that it uses little water. The present machine (on front page) uses between four and five times as much for the same effect. This would be a disadvantage where water is scarce, and it was for such cases that the U. C.

machine was recommended in Bulletin No. 117. Where the cost of water is merely nominal for the amounts necessary, as it is in most California wineries, the possibility of cooling nearly twice as much wine in a given time with a machine of the same size of our present construction is a great advantage.

Several cellars in California have installed a cooling device consisting of a system of iron water-pipes arranged in various ways in the interior of the fermenting vat itself. The pipes are usually arranged around the cask at a few inches from the staves, but are sometimes placed in an upright series in the middle of the vat extending from one side to the opposite, and from the bottom to the top. The wine is kept cool by running water through this system of pipes whenever the temperature rises too high. With such a device it is possible to control the temperature, but in order to keep the temperature approximately even in all parts of the vat, constant stirring during the tumultuous fermentation is necessary. This is troublesome, and with very large vats impossible. Instead of stirring, the temperature may be equalized by pumping the wine over from the bottom of the vat to the top of the pomace; but if this method is used, more pumping is needed than is necessary for our machine. The amount of water necessary to obtain the same effect is about twice that used in our cooler. The principal defect in this device, however, is the difficulty of removing the pomace and the cleaning of the vat, owing to the presence of the network of pipes and supports.

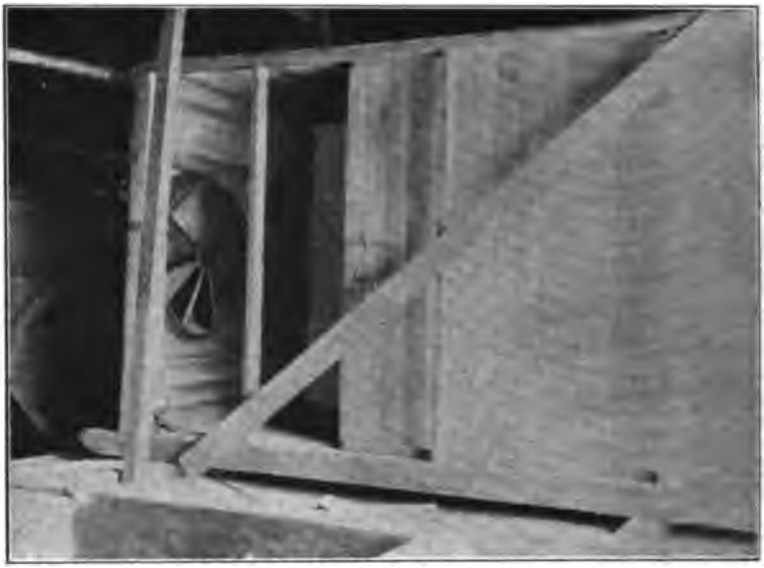

FIG. 2. Another form of air-blast cooler.

It is also expensive to install, as a series of cooling pipes must be placed in every vat. Moreover, although it has been shown that a limited exposure of the wine to contact with iron has no bad effects, it is probable that the continued presence of so much iron piping in the wine for four or five days would have an injurious effect.

Copper or Iron Pipe.—Though the machine is by no means expensive, it could be made for little more than half the cost if it were possible to use iron pipe instead of copper tubing. Iron being a poorer conductor of heat than copper, an iron pipe would be less efficient than a copper tube, but tests with a small model of the cooler indicate that there would be a loss of only about 10 per cent in efficiency, which would not counterbalance the difference of cost. The acids of the wine act more energetically on iron than on copper, but the time during which the wine is in contact with the metal is so short that this need not be taken into account. To test this, a piece of ordinary black iron water-pipe was immersed in red wine and left there sufficiently long to make the time of contact one hundred times what would occur in a single cooling of the wine. The wine was then heated to 100° F. and left again in contact for twenty times the length of an ordinary cooling. At the end of this time, the color of the wine had not been affected at all, either in tint or intensity. Twenty-four hours later the wine was examined again by means of a Salleron vino-colorimeter, and no change could be detected. As iron salts act very rapidly on the color of red wine, this may be taken as proof that no ordinary cooling through iron pipes

FIG. 3. Iron tank used for transportation of wine in Algeria.

would affect the wine in the least. Moreover, in most cellars now, the must is pumped from the crusher to the vats through iron pipes without any injury. In Algeria, after many attempts to find a suitable coating for the inside of the iron tanks used in transporting wine from outlying wineries to central storage cellars, it has been found best to leave them uncoated and no deleterious effects follow. (See Fig. 3.)

Galvanized iron pipes, however, should not be used, as the zinc is soon corroded by the wine, and the zinc salts which thus get into the wine are poisonous and might cause the wine to be rejected if exported. We can not, however, recommend iron pipes at present for use in a cooling machine, as we have not yet tested them on a practical scale. There is danger that, owing to the roughness of their interior surfaces, they might retain the sediment and choke up. However, the cooler described on page 43 of Bulletin No. 167 is constructed of iron pipes, and is said to work satisfactorily during a whole vintage without any cleaning except flushing with hot water.

The Water Hose.—The exterior tube through which the water runs and the function of which is to keep the cool water in contact with the tube containing the hot wine, may be made of metal or any substance that will conduct the water.

For reasons of economy and ease of construction a canvas hose was chosen. Woven cotton and linen fire-hose were first tested and found perfectly satisfactory. As soon as the tissues of the hose were thoroughly soaked with water, the leakage was reduced to a simple sweating. This sweating, as will be shown later, is a distinct advantage, as it permits a certain amount of evaporation, which has the effect of cooling the water and thus increasing its effect on the cooling of the wine.

As woven hose is very expensive, a test was made with ordinary sewn canvas irrigating hose. In the preliminary trials it seemed that all the hose of this kind procurable leaked too much to allow any benefit to be obtained from the evaporation, and a great deal of water escaped before its cooling power had been completely utilized. As there was, however, an abundance of water available at the cellar where the experiments were to be tried, it was determined to use this kind of hose in the construction of the cooler.

Various kinds of canvas were tried and their relative rates of leakage determined under conditions as near those of practice as possible. The amount of leakage was found to vary very much with different qualities of canvas. In general, the stronger and coarser canvas leaked the most, though the very fine canvas also leaked more than the medium grades. It is possible that in time, after long use, the heavier grades would have ceased to leak so copiously, for the grade which was adopted leaked much less in actual practice after it had been in use for a few days than had been anticipated after the laboratory tests. The grade adopted was Neville's No. 10. The grades lighter than this seemed hardly strong enough, and the heavier leaked more.

Even the No. 10 canvas leaked so much at first that during the first cooling experiments the exit of the hose was kept closed, and all the water used was forced by the pressure through the pores of the canvas. When used in this way the efficiency of the machine was much diminished, as is seen by comparing the factor K of tests 1, 2, and 3 in Table I with that of tests 8, 9, and 10. When the leakage had been diminished as much as possible, the efficiency of the machine was nearly doubled. The reason of this is, of course, that when excessive leakage occurs a great part of the water escapes before its cooling capabilities have been utilized.

The best method of diminishing the leakage was found to be, after setting up the machine, to close the exit of the hose and then allow the water to enter at full pressure. There is no danger of bursting the hose unless there is an excessive supply of water, as 240 feet of 4-inch hose was found at first to be able to leak 750 gallons per hour under a pressure of about 40 feet, coming through a 1-inch water-pipe. In an hour or two the leakage diminishes considerably, and then, when the exit is opened, it becomes very little. Each time the machine was used, the leakage became less, until after the third or fourth day the leakage was little more than was needed to keep the outside of the hose moist and so obtain the cooling effect of evaporation. Each time the hose was filled, after having been allowed to become dry, it was found necessary to swell it up again by closing the exit at first. This required only a few minutes, however, and not an hour or two as when the hose was new.

An improvement on the design of the machine would be to let the hose lie in a half-round gutter exactly fitting the hose. This would cause most of the leakage to be through the upper part. In this way all the water which escaped would be warm, and the efficiency of the machine would be increased by getting rid of it. In the machine as actually constructed the hose lay on the edge of a straight board, one inch thick, the object being to expose as much surface as possible to the evaporating effect of the dry air. While the machine was working, the difference of temperature between the upper and the lower surfaces of the hose was marked, the water, as it was warmed, rising and flowing in a stream overlying the cool stream of water below. As undoubtedly, owing to the greater pressure, more than half of the leakage took place on the lower half of the surface of the hose, a means of causing all the leakage to be at the expense of the warmer water in contact with the upper surface might be an advantage.

Cooling Due to Evaporation.—In the preliminary tests, made before constructing the machine, it was found that more cooling was obtained than could be accounted for by the rise of temperature of the water used; that is to say, the warm stream was cooled more than the cool stream was warmed. This could be accounted for in the model only by the cooling due to evaporation from the hose as the water passed through. Calculations based on tests made with the model showed that this cooling would amount to a little more than 0.5° F. with a machine of the size of the final cooler when passing 1,000 gallons of wine per hour under the atmospheric conditions surrounding the model. The relative humidity of the air when the tests were made was 60. The mean relative humidity of the air at Fresno during the month of September is given by the Weather Bureau as 42 as an average of twelve years, and as the cooler is used principally during the day when the air is driest, it was expected that the cooling due to evaporation would be much greater in practice than was indicated by the tests of the model.

This expectation was abundantly verified by the practical tests of the large cooler used at Fresno. The following table is calculated from the data given in Table I:

TABLE II.

Comparison of Heat Lost by the Wine, and of Heat Gained by the Water.

Experiment.	Calories Lost by Wine.	Calories Gained by Water.	
1	1,000	819	End of hose closed.
2	1,000	833	
3	1,000	802	
4	1,000	1,577	End of hose open: much leakage.
5	1,000	1,500	
6	1,000	1,846	
8	1,000	926	End of hose open; very little leakage.
9	1,000	939	
10	1,000	802	

In the first three experiments, where the exit end of the water hose was closed, the cooling by evaporation is shown by the table above to be considerable, and corresponds to a lowering of the temperature of the water 3° F. In the second three experiments there is an apparent reversal of this effect, due to the fact that the temperature of the warmed water was taken as it emerged from the exit. This did not give the average temperature of the water, but something higher, as the warmer water in the upper part of the hose traveled more freely and reached the end, while much of the cooler water escaped by leakage before it reached the end. When the hose leaks as much as it did during these experiments, much of the cooling power of the water is lost and the use of the semi-circular trough suggested above would be very effective.

When the leakage had diminished to a mere sweating of the hose, as in the last three experiments, the cooling effect of evaporation is again evident. In experiments 8 and 9 this effect corresponds to 2.5° F. and 2.3° F. respectively, while in experiment 10, where the water was passing more slowly, it is increased to 4.1° F.

In the first three tests some of the difference shown between the rise of temperature of the water and the fall of temperature of the wine may be due to the difference between the specific heats of water and of half-fermented wine. The latter difference, however, is too small to account for all of the former. In the last three experiments this source of uncertainty is eliminated, as warm water was used instead of wine in making the tests.

Under average working conditions in a dry climate it may be expected that the results of evaporation from the canvas hose will be equivalent to the use of water about 3° F. cooler in a machine where this evaporation could not take place.

Effect of Sunshine, Shade, and Wind.—The machine should be placed in such a position that the greatest possible benefit may be derived from the effects of evaporation. This will be in a *shady* place where the canvas hose is exposed to the full force of any wind that may be blowing. It should not be inside a building where it is protected from the wind, and where the air may be rendered moist by the vapors given off by fermenting wine or by water used in washing. The heat and dryness outside promote evaporation from the hose, and consequently increase the efficiency of the cooler The direct rays of the sun, however, should not strike the cooler, for in this case the radiant heat will warm the water more than the evaporation cools it. In a test with a small model cooler it was found that where in the shade the water was cooled 0.5° F. by evaporation, the resultant of the effects of radiant heat and evaporation in direct sunshine was a rise of 1.25° F.

Relative Positions of Canvas Hose and Copper Tube.—Tests were made with a small model to determine the effect of placing the copper tube in different positions in the canvas hose. Four tests were made, as indicated in Fig. 4. In A, the tube was placed as near the upper part of the hose as possible; in B, in the center; in C, as near the lower part as possible. In D, spiral flanges were soldered to the tube, with the object of making the stream of water circulate around the tube in its

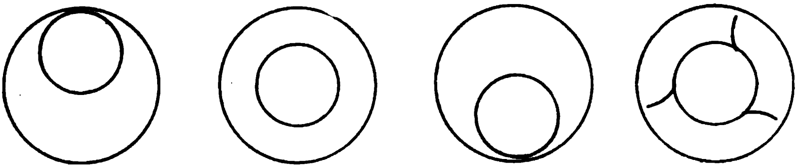
A—10.0° F. B—15.3° F. C—15.6° F. D—16.0° F.

FIG. 4. Comparative cooling, corresponding to different positions of tube.

passage from one end of the hose to the other. When the tube was placed near the upper part of the hose the wine was cooled less than two thirds as much as when placed in the other positions. The most effective method was where spiral flanges were used, but the superiority over the plain tube when placed in position C was so little that it would not repay the extra expense and trouble involved in the use of the flanges.

The position C was adopted in the construction of the machine. This is the position the tube and hose naturally take when the hose is inflated by the pressure of the water, if they rest on a flat, continuous surface. The tube is kept in a position which leaves a small space between it and the lower surface of the hose by means of the couplings which are necessary to join the 20-foot lengths of copper tubing which were used in the construction of the machine. These couplings should be as small as practicable. A hose coupling is too large and would obstruct the passage of the water too much. A very good coupling was designed by Mr. Meakin, which projects only one quarter of an inch from the tube and was found to answer the purpose perfectly. Fig. 5 shows the relative positions and actual sizes of hose, tube and couplings, and support. The small space between the lower surface of the copper tube and the hose is an advantage, as it increases the cooling surface in contact with the cooler water, which has a tendency to run along the lowest part.

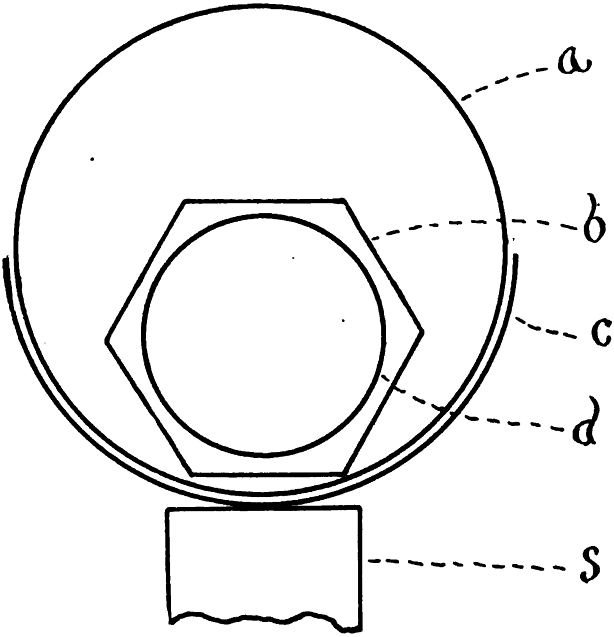

FIG. 5. Cross-section of cooler showing relative positions of hose, tube, support, and proposed gutter. *a*, canvas hose; *b*, couplings of copper tube; *c*, gutter; *d*, copper tube; *s*, support.

Support of Cooler.—The cooler should be placed on a support that raises it a few feet from the ground, both for convenience of working and to expose it more perfectly to the wind.

In order to control the amount of leakage, and to prevent more leakage in one part of the machine than in another, some method must be adopted of varying and equalizing the water pressure in all parts of the hose. This it was found possible to do in the machine constructed by the means indicated in Fig. 6. The 220 feet of tubing was made in four lengths joined by three semi-circular bends, as shown in the figure referred to. The support was built to give a fall of 3 feet in the entire length, and as the water passed from the upper end to the lower the fall tended to restore the pressure lost by friction and leakage. The amount of pressure was determined by 8 or 10 feet of rubber wine hose attached to the lower end through which the water escaped. By raising the end of this piece of hose, as at E_1, the pressure could be increased, and by lowering it decreased, to any required degree. For the purpose of swelling up the canvas hose a maximum pressure was obtained by screwing a cap on the end of the hose at E_1. When the machine is in working order, the best height for the exit E_1 is easily found by trial.

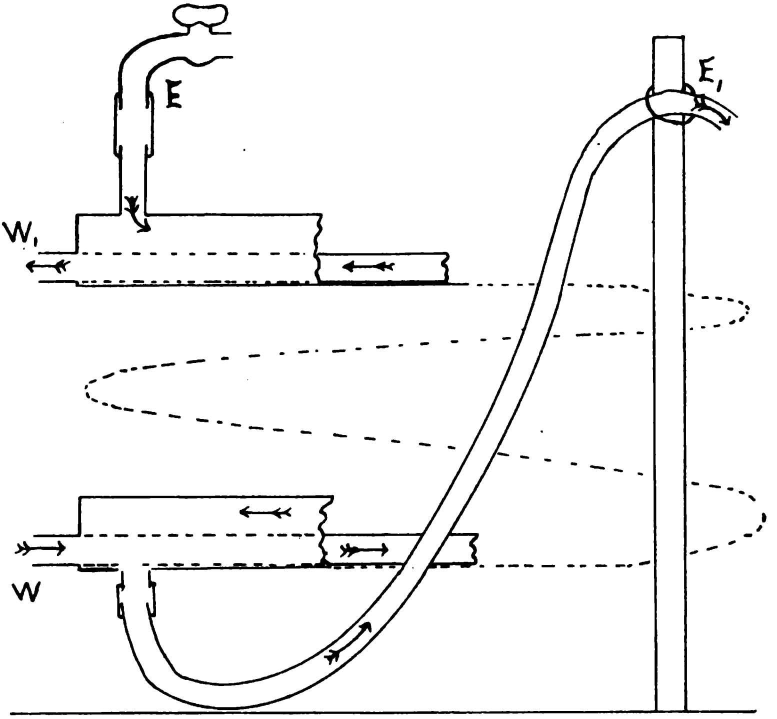

FIG. 6. Scheme of Cooling Machine.

W =Entrance of warm wine.
W_1=Exit of cooled wine.
E =Entrance of cool water.
E_1 =Exit of warmed water.

The wine enters the lower end of the machine at W and escapes at the upper, W_1. This upward passage of the wine is desirable, as it prevents any interference with the flow due to the gas given off freely by the fermenting wine. The gas is carried upward regularly and perfectly.

Temperature of the Water.—A certain amount of cooling will be obtained whatever the temperature of the water, provided it is lower than that of the wine, but the cooler the water the more effect it will have. This is shown by the following tests made with the model cooler:

TABLE III.

Comparison of the Effects of Water of Different Temperatures.

Temperature of Water.	1st Temp. of Wine.	2d Temp. of Wine.	Degrees Cooled.
65° F.	92° F.	82.0° F.	10.0° F.
75	92	85.5	6.5

Thus, with the same conditions of flow and of temperature of wine and water, water at 65° F. reduced the wine 10° F., and water at 75° F. only 6.5° F. In practice it will probably be found that the necessary efficiency will be obtained with this machine only if the temperature of the water available is at least 20° F. lower than that of the maximum temperature which it is desired that the wine shall not exceed. That is to say, if it is desired to keep the fermenting wine below 92° F., the water used must not exceed 72° F. (See test 3, Table I.) When there is a difference of only 14° F., for example, the wine can be cooled only 5° F. at a practical rate. (See test 7, Table I.) This is too little for practical purposes. It is very necessary, therefore, that the water should be as cool as possible. For this reason it will usually be necessary to have a special reservoir or water tank for the use of the cooler.

The water as it came from the well which was used in our cooling experiments had a temperature of 66° F., which was quite low enough for efficient cooling. After this water had been in a 20,000-gallon iron tank, covered above but exposed to the sun on the sides, for two or three days its temperature would often rise to over 80° F., which was much too warm for the purpose. Even during the vintage, when a great deal of water was being used and water was almost continually being pumped into the tank and drawn out, it was usually over 71° F. when it reached the cooler.

The water tank should be completely protected from the direct rays of the sun. The best way to do this would be to place a roof over it and then surround it with a screen which would keep off the sun but allow free circulation of air. If the sides of the tank were covered with canvas kept wet by some automatic sprinkling device, it is probable that the water instead of becoming warmer in the tank would be cooled. If this were done, the tank might be made large enough to hold the water needed for several days.

It would be possible to pump directly from the well into the cooler, but this would be less convenient, as it would necessitate a special pump and well for the purpose and would require more supervision.

Temperature of the Must or Wine.—With water at a given temperature, the hotter the wine the greater difference there will be between the temperature of wine and water, and therefore the more efficient the machine. Tests with the model cooler gave the following ratios:

TABLE IV.

Efficiency with Wine of Different Temperatures.

1st Temp. of Wine.	2d Temp. of Wine.	Temperature of Water.	Degrees Cooled.
100° F.	86.0° F.	66° F.	14.0° F.
92	82.0	66	10.0
84	76.3	66	7.7

Thus, with all other conditions the same, the amount of cooling was nearly twice as much with wine at 100° F. as with wine at 84° F. The same is shown to be the case with the large cooler, as may be seen by comparing tests 4 and 6, where, the other conditions being identical, must at 109° F. was reduced 26° F., and must at 92° F. only 13° F.

This shows that to obtain the maximum amount of work out of the machine the cooling should commence when the temperature of the wine is very near the maximum which it is to be allowed to reach. If the wine is to be allowed to reach 95° F. much time and labor is wasted by commencing to cool it when it has reached only 90° F., and still more if, as is sometimes advised, we cool the must before it has commenced to heat at all.

Ratio of Volumes of Wine and Water.—The less wine we pass through the machine per hour and the more water, the greater cooling effect we will obtain. If, however, we pass the wine too slowly, we do not get enough work out of our machine, and on the other hand, if we pass the water too quickly, we lose too much of the cooling power of our water. The differences obtained with the model cooler with different ratios of water and wine are shown by the following results of tests:

	Degrees Lowered.
Rate of water equal to that of wine	10.0° F.
Rate of water 1½ times that of wine	11.3
Rate of water 2 times that of wine	13.2

These tests indicate that with a machine of this construction it would not pay to use more water than wine, for while an equal quantity lowered the wine under the conditions of the test 10° F., double this quantity lowered it only 3.2° F. more.

With the large machine it was found that satisfactory results were obtained when using a little less water than wine. (See test 10, Table I.)

Rate of Pumping.—The rate at which the wine should be passed through the machine to obtain the maximum efficiency is a function of the particular machine, and will differ according to its size. The machine used was found to work very satisfactorily when cooling 1,000 gallons per hour. (See tests 8, 9, and 10, Table I.)

In order to calculate the size of machine necessary to accomplish a certain amount of cooling with a certain amount of water at a given temperature, a formula deduced from that given on page 3 may be used:

$$S=\frac{R\times F}{D\times K}$$

The factor K will undoubtedly differ according to the size of the machine and according to the diameter of the copper tubing used, but unless these are very different from the machine described here, it will be approximately equal to 9 within the limits of cooling that will be used in practice. If, then, we take K to be 9, the volume of wine (R) to be cooled per hour as 1,000, and the number of degrees (F) which it is desired to cool the wine as 15, we can calculate the required cooling surface (S) as follows:

$$S=D\times\frac{15000}{9}$$

From S obtained in this way we can calculate the length (L) of copper tubing required according as we use 1¼-inch, 1½-inch, or 2-inch tubing, as follows:

$L=S\times 3.054$, for 1¼-inch copper tubing.
$L=S\times 2.545$, for 1½-inch copper tubing.
$L=S\times 1.909$, for 2-inch copper tubing.

The following table has been computed in this way for some of the commonest cases that are likely to occur:

TABLE V.

Length of Cooler Needed for Various Conditions.

R=Rate.	Temperature of Water...	Temperature of Wine....	D	F	K	S	L=Number of Feet Copper Tubing. 1¼-inch.	1½-inch.	2-inch.
1,000 gallons per hour	65°	95°	30	15	9	59.3	181	151	114
	65	92	27	15	9	65.9	201	168	126
	72	95	23	15	9	76.4	233	194	146
	72	92	20	15	9	88.9	272	226	170

With the larger copper tubing, as indicated by certain tests made, it is probable that the efficiency would be a little less, so that it would probably be necessary to use a little more tubing than is indicated in the last column.

Specifications for a Cooling Machine.—In order to give an idea of the cost of a machine of this construction, the following list of materials is given for a machine suitable for the use of a cellar making not more than 300,000 gallons of dry wine during a vintage of thirty days:

Bill of Materials.

Copper tubing, 200 linear feet of 1½-inch, @ 46 cents	$92 00
Canvas irrigating hose of No. 10 canvas, 200 linear feet, 3 inches in diameter, @ 5c.	10 00
Two brass castings for the ends of cooler, @ $2.25	4 50
Nine couplings for copper tube, @ 45 cents	4 05
Three copper semi-circular bends for tubes, @ $2.60	7 80
Three galvanized iron bends for hose, @ 35 cents	1 05
Three pieces of galvanized iron piping for hose, @ 20 cents	60
Half-round galvanized iron guttering, 200 feet, @ 6 cents	12 00
Wooden stand	20 00
Ten feet of 3-inch rubber hose, with cap	7 50
	$159 50

The following table shows how much a machine of this size would reduce the temperature of wine at 95° F. and at 92° F. with water at 65° F. and 70° F., when working at the rate of 1,000 gallons of wine per hour and using an equal quantity of water:

TABLE VI.

Reduction of Temperature of Wine under Various Conditions.

Rate.	Temperature of Water.	Temperature of Wine.	Reduction of Temperature.
1,000 gallons per hour.	65° F.	95° F.	21° F.
	65	92	19
	70	95	18
	70	92	16

A machine of this size would be quite sufficient, if used ten hours per day under ordinary conditions, to control the temperature of the wine in a cellar which crushed 50 tons per day of red grapes for dry wine. By running the machine day and night the capacity could be more than doubled, which would be a sufficient safety factor to provide for extraordinarily hot weather or the crushing of more than the average amount during a part of the vintage.

There is also the possibility of the vats filled on separate days requiring cooling on the same day, but a competent wine-maker who attends to the proper starting of his fermentations can nearly always avoid this.

Method of Using the Cooler.—In order to obtain the full benefit of the cooling machine (that is, to use it with the greatest efficiency), certain facts must be kept in mind and a plan of cooling adopted in accordance with these facts.

Every gram of sugar in a hundred cubic centimeters of must in fermenting will generate enough heat to raise the must 2.34° F. This corresponds, very nearly, to the production of 2.34° F. for every degree

Balling of the must. This heat is disposed of in three ways: (1) A portion is taken up by the must, which is thus raised in temperature; (2) another portion escapes from the must by radiation and conduction; and (3) the remainder should be removed by the cooler.

If we know how much heat will be taken up in the first two ways, we will know how much it is necessary to remove by the third.

To determine this we first calculate how much heat will be developed by the fermentation of all the sugar present, and add this to the temperature of the must. This will give us the number of degrees of temperature which must be disposed of in the three ways. For example, if the must has 24 per cent of sugar, there are 24 × 2.34 degrees, or 56° F. to be disposed of. If the grapes on crushing have a temperature of 70° F., and we are to allow the fermentation to reach a maximum of 92° F., they will take up 92—70, or 22° F. This leaves 34° F. to be removed by radiation and cooling. Experiments have shown that in the more usual methods of fermenting red grapes in California, about half of the heat generated by fermentation will be lost by radiation. Thus, 56 ÷ 2, or 28° F., will escape in this way. This leaves 34—28, or 6° F., to be removed by the cooling machine, if we desire the fermentation not to exceed a temperature of 92° F. To keep it below 90° F. we should have to remove 8° F., while if we are to allow it to reach 98° F. no cooling at all will be necessary.

TABLE VII.

Removal of Heat by Radiation and by Cooling.

Experiment.	First Temp.	Max. Temp.	Last Temp.	Sugar Fermented	Degrees F. Generated.	Degrees F. Removed by Cooler.	Degrees F. Lost by Radiation.	Number Days in Vat.
No. 1	84	96	93	21	49	20	20=41%	4
No. 2	71	96	94	19	44	6	15=34%	3
No. 3	74	98	90	17	40	6	18=45%	6
No. 7	81	98	92	17	40	0	29=73%	4
No. 9	84	92	79	24	57	27	35=61%	3
							Mean = 51%	

Table VII shows the amount of heat removed by radiation in five of the experimental fermentations made at Fresno. The amounts vary considerably—from 34 to 73 per cent. The cause of this is that the fermentations were experimental and conducted in various ways. The average of all is, however, 51 per cent, or about half.

Calculations based on the series of fermentations described in Bulletin No. 159 show much less variation, the following losses of heat in twelve fermentations being found: 53, 67, 48, 55, 55, 50, 53, 48, 59, 56. 55, 50 per cent, being on the average 54 per cent. These fermentations were conducted in the ordinary way, in open vats holding about 4,000 gallons.

The amount of heat lost by radiation will depend on the outside temperature surrounding the vat, the size and shape of the vat, and the amount of stirring and pumping-over that is practiced. For the purposes of our calculations it may be taken that in ordinary open fermenting vats not exceeding 3,000 gallons capacity the loss will be 50 per cent, except in the hottest weather. In larger vats up to 10,000 gallons capacity, and in very hot weather, the loss may be no more than 33 per cent.

Using these figures we may calculate the amount of cooling necessary, as follows:

Let—

S = Sugar (% Balling) contained in the must.
T = Temperature of contents of vat.
M = The maximum temperature desired.
C = The number of degrees necessary to remove by cooling.

Then,

$$C = 1.17\,S + T - M.$$

Example:

$S = 24\%$; $T = 80°$ F.; $M = 92°$ F.

Then,

$$C = (1.17 \times 24) + 80 - 92 = 16.$$

In this case, therefore, it would be necessary to remove the equivalent of 16° F. from every gallon of fermenting grapes in the vat.

This formula may be used at any time, but it is best to wait until the temperature of the fermenting vat nearly reaches the desired maximum before making the calculation and before commencing the cooling.

The calculation is less liable to error at this time, because the grapes and must have already taken up all the heat they can without surpassing the maximum chosen, and the contents of the vat have become more thoroughly mixed so that our test of the sugar-contents is more likely to properly represent the whole vat.

The following table shows some examples of the results we would get by making these calculations:

TABLE VIII.

S = Sugar.	T = Temperature of Must.	C = Cooling Necessary for a Maximum (M) of— 90°	93°	96°
24%	70°	8°	5°	2°
24	80	18	15	12
22	60	0	0	0
22	70	6	3	0
22	80	16	13	10

This represents such calculations as might be made as soon as the vats are filled. If we wait until the maximum temperature is reached we would get such results as the following:

TABLE IX.

S=Sugar.	T=Temperature of Must.	C=Cooling Necessary for a Maximum (M) of—		
		90°	93°	96°
10%	90°	12°	9°	6°
10	93	--	12	9
10	95	--	--	11
6	90	7	4	1
6	93	--	7	4
6	95	--	--	5

It is highly desirable that we postpone the use of the cooler until the vat has very nearly reached the maximum temperature desired, for it is only in this way that we can obtain the maximum efficiency for our machine.

When we have thus found C*, the number of degrees which the whole contents of the vat must be lowered, we can easily determine how much the cooler should be used. If 10,000 gallons are to be cooled 5 degrees, it does not matter whether we pass 10,000 gallons through the cooler taking 5° F. from every gallon passed, or whether we simply pass 5,000 gallons taking 10° F. If the contents of the vat are thoroughly mixed, as they will be during the operation, the final effect will be the same, namely, the reduction of the temperature of the whole 5° F.

For every machine there will be a certain rate of pumping and a certain amount of lowering of the temperature corresponding to the greatest efficiency of the machine. This rate and this degree of cooling must be determined for each machine, and will depend principally on the size of the machine and the temperature of the water. In the machine used at Fresno, they were 1,000 gallons per hour and a reduction of 15° F. To determine the time, therefore, during which we must use the cooler on a certain vat, we first determine C as above and then make use of the following formula:

$$H=\frac{G\times C}{R\times F}$$

Where

H = The number of hours the cooler must be used.
G = The number of gallons of grapes in the vat.
C = The number of degrees F. which the whole vat must be lowered.
R = The number of gallons per hour passed through the cooler.
F = The number of degrees lost by the wine passing through the cooler.

For example, let

$$G=2500;\ C=10;\ R=1000;\ F=15.$$

Then,

$$H=\frac{2500\times 10}{1000\times 15}=1.67, \text{ or 1 hour 40 minutes.}$$

---

*C can be found without calculation by referring to Tables XIII and XIV at the end of this bulletin.

In order to use the cooler effectively, it is necessary to watch closely the rise of temperature and disappearance of sugar, as is done in every well-conducted cellar. These observations should be made at least twice a day, and oftener when the temperature approaches the critical point. From these observations some such table as those shown below should be constructed. This will enable us to start the cooling at the right moment, and in a few seconds to calculate the amount of cooling necessary.

TABLE X.

Examples of Control of Temperature with Cooler.

I. Vats 1000-3000 gallons. Moderate weather. Quick fermentation. Heat radiated, one half of that generated by fermentation.

	a r.	Sugar Lost.	Heat Generated.	Heat Lost by Radiation, etc.	Temperature of Vat.	Degrees Removed from Vat.
At crushing	24%B				80°F	
		3%B	7.02°F	3.02°F		
At 1 day	21				84	
		6	14.04	7.04		
At 2 days	15				91	
		3	7.02	4.02		
At 2½ days	12				94 (81)	13°F
		7	16.38	8.38		
At 3 days	5				89	
		5	11.70	5.70		
At 4 days	0				95	

II. Vats 1000-3000 gallons. Moderate weather. Slower fermentation. Heat lost, one half.

	a r.	Sugar Lost.	Heat Generated.	Heat Lost by Radiation, etc.	Temperature of Vat.	Degrees Removed from Vat.
At crushing	24%B				70°F	
		2%B	4.68°F	1.68°F		
At 1 day	22				73	
		5	11.70	5.70		
At 2 days	17				79	
		9	21.06	11.06		
At 3 days	8				89 (81)	8°F
		6	14.04	7.04		
At 4 days	2				88	
		2	4.68	2.68		
At 5 days	0				90	

III. Vats 5000-10,000 gallons. Or warm weather. Heat lost, one third.

	a r.	Sugar Lost.	Heat Generated.	Heat Lost by Radiation, etc.	Temperature of Vat.	Degrees Removed from Vat.
At crushing	24%B				80°F	
		3%B	7.02°F	2.02°F		
At 1 day	21				85	
		6	14.04	4.04		
At 2 days	15				95 (80)	15°F
		10	23.40	8.40		
At 3 days	5				95 (87)	8°F
		5	11.70	3.70		
At 4 days	0				95	

Example I represents a fermentation of grapes containing 24 per cent of sugar which were crushed warm (80° F.), and of which the maximum temperature attained during fermentation was 95° F. The cooling necessary for 2,500 gallons of fermenting grapes, with our machine, is found by using the formula given on page 20:

$$H=\frac{2500 \times 13}{1000 \times 15}=2.17, \text{ or 2 hours 10 minutes.}$$

In example II the grapes were cooler when crushed and the temperature was not allowed to exceed 90° F. The cooler was used as follows:

$$H=\frac{2500 \times 8}{1000 \times 15}=1.34, \text{ or 1 hour 20 minutes.}$$

In example III it is supposed that on account of hot weather and large vats the loss by radiation was only one third of the heat generated by fermentation. In this case, C, the number of degrees which it is necessary to lower the whole vat, is found by modifying the formula on page 19:

$$C=1.56\,S+T-M.$$

In this case, if we are dealing with a vat containing 9,000 gallons of crushed grapes, the time our cooler would have to be used is as follows:

$$H=\frac{9000 \times 23}{1000 \times 15}=13.8, \text{ or 13 hours 50 minutes;}$$

or, as represented in the table, one cooling of 9 hours one day and another of

$$H=\frac{9000 \times 8}{1000 \times 15}=4.8, \text{ or 4 hours 50 minutes}$$

the next.

It is not necessary that the temperature of the vat after cooling should be as low as is indicated by the figures in parentheses in the last column but one of Table X. These figures simply represent the temperature which would be necessary if the cooling were instantaneous. As the cooling takes time, heat is being generated by the fermentation at the same time that the cooler is removing heat. The final temperature of the vat, therefore, after the cooling, will be higher than that represented by the figures in parentheses. The difference will be very slight in the case of small vats, which are cooled quickly, but considerable in the case of large vats. In a 10,000-gallon vat, under the conditions represented in example III, during the first cooling of 9 hours, 15° F. would be removed by the cooler, but at the same time about 4° F. would be added by fermentation, so that when the cooling was finished the temperature of the vat would not be 80° F., but 84° F.

This does not mean that the cooling has not been so effective as the calculation indicated. The production of heat has been accompanied by a diminution of sugar, and the possibility of a rise of temperature in so far diminished. The effective cooling therefore has been 15° F., as shown by calculation. This shows the need of making these calculations, for it is impossible to tell simply by testing the temperature of the vat when sufficent cooling has been effected.

Cooling White Wine.—It is much more rare to find white wines failing to ferment out dry than red. The reason for this is that they much more rarely attain high temperatures during fermentation. There are several causes for this. In the first place the absence of a cap of pomace permits the heat to radiate off more freely; and in the second place, white wines are usually fermented in smaller casks or vats, which is also an aid to heat radiation; and finally, white musts are usually sulfured, which makes the fermentation slower, and this gives the heat generated more time to escape.

This is well shown by the record of two fermentations in puncheons of white wine made this year at Fresno:

TABLE XI.

Loss of Heat by Radiation in Puncheons of Fermenting White Wine.

	Sugar.	Temperature Observed.	Heat Generated.	Loss by Radiation.
Experiment VI.				
At crushing	22.5%B.	78° F.		
At 1 day	16.7	85	13.5° F.	48%
At 2 days	9.1	88	17.8	84
At 3 days	4.7	88	10.3	100
At 4 days	2.8	88	4.5	100
At 5 days	2.0	87	2.0	150
Total loss of heat by radiation				81%
Experiment VIa.				
At crushing	25.0%B.	78° F.		
At 1 day	17.0	88	18.5° F.	46%
At 2 days	8.7	92	19.5	80
At 3 days	5.9	89	6.5	146
At 4 days	4.4	87	3.5	157
Total loss of heat by radiation				80%

In the first of these cases enough of the heat generated by the fermentation of 20.5% B. of sugar was lost by radiation to prevent the temperature of the wine rising above 88° F.

In the second case, the fermentation started more rapidly during the first day, and although the total heat lost during four days was practically the same as in the first case, there was more generated the first day, which shows itself in the rise to 88° F. instead of to 85° F., as in the first case. This rapid start caused the maximum temperature to be 3 degrees higher, e. g. 92° F.

This exemplifies the danger of starting the fermentation too rapidly by adding too large a quantity of yeast or starter.

When the maximum temperature is reached, as much or more heat is lost by radiation as is generated by fermentation. In a properly conducted fermentation of red wine this does not usually occur until the wine is nearly dry. With white wine in small casks, owing to the much greater loss of heat, this usually occurs when the wine still contains 4 or 5 per cent of sugar. In cold seasons and localities the fall of temperature may be so rapid as to check the fermentation.

While a cooling machine is rarely needed for white wines when fermented in small casks, it is quite otherwise when the fermentation takes place in large casks or vats. This is exemplified by the record of a 1,600-gallon cask of Burger made at Fresno this year.

TABLE XII.

Loss of Heat by Radiation and Cooling in a 1,600-gallon Cask of Fermenting White Wine.

Experiment VIII.	Sugar	Temperature Observed.	Heat Generated.	Heat Lost by Radiation.
At crushing	21.5%B.	80°F.		
At 1 day	7.0	90	34.0°F.	70%
		Cooled to 80°F.		
At 2 days	2.1	86	11.5	43%
At 3 days	1.0	89	2.5	

Heat lost by radiation	60%
Heat lost by cooling	21%
Total	81%

In this case the heat lost by radiation, 60 per cent, is little more than in the red wine fermentation. If the wine had not been cooled when it reached 90° F., it would have risen to 95° or 96° F. The heat lost by radiation and removed by cooling in the 1,600-gallon cask were, together, capable of keeping the maximum only as low as it was kept in the 180-gallon puncheons by radiation alone.

TABLE XIII.

Showing C, the Number of Degrees F. to Cool the Must or Fermenting Wine to Prevent the Temperature Rising Above 90° F.

For vats not exceeding 3,000 gallons and cellars not hotter than 80° F.

$C = 1.17\,S + T - M.$

T = TEMPERATURE

S = SUGAR

	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	M= 90
30	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
29	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
28	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
27	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
26		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
25			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
24				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
23					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
22						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
21							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
20									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
19										1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
18											1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
17												1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
16													1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
15														1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
14																1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
13																	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
12																		1	2	3	4	5	6	7	8	9	10	11	12	13	14
11																			1	2	3	4	5	6	7	8	9	10	11	12	13
10																				1	2	3	4	5	6	7	8	9	10	11	12
9																					1	2	3	4	5	6	7	8	9	10	11
8																							1	2	3	4	5	6	7	8	9
7																								1	2	3	4	5	6	7	8
6																									1	2	3	4	5	6	7
5																										1	2	3	4	5	6
4																											1	2	3	4	5
3																												1	2	3	4
2																														1	2
1																															1
0																															

TABLE XIV.

Showing C, the Number of Degrees F. to Cool the Must or Fermenting Wine to Prevent the Temperature Rising Above 95° F.

For vats exceeding 5,000 gallons and cellars hotter than 80° F.

$C = 1.56S + T - M.$

T = TEMPERATURE

S = SUGAR

	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	M= 95
30	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
29	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
28	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
27	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
26	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
25	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
24	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
23	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
22	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
21	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
19		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
18				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
17					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
16							1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
15									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
14										1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
13												1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
12													1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
11															1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
10																1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
9																		1	2	3	4	5	6	7	8	9	10	11	12	13	14
8																			1	2	3	4	5	6	7	8	9	10	11	12	13
7																					1	2	3	4	5	6	7	8	9	10	11
6																							1	2	3	4	5	6	7	8	9
5																								1	2	3	4	5	6	7	8
4																										1	2	3	4	5	6
3																											1	2	3	4	5
2																													1	2	3
1																														1	2
0																															

Notes on the Use of Tables XIII and XIV.—To use these tables we must first determine the temperature and degrees Balling of the must in the vat. Then by following the horizontal line opposite the number representing the degrees Balling until it intersects the vertical line running from the number representing the temperature we find a number which shows the number of degrees F. which the contents of the vat must be lowered. This number we call C. Then by using the formula given on page 20 we find how long the cooler should be used in the vat. This formula and one of the above tables are all that are necessary for the effective and economical working of the machine. For example:

Grapes at 20 per cent Bal. if crushed at 64° F. will not rise above 90° F., and therefore need no cooling. Grapes with the same amount of sugar but crushed at 79° F. must be cooled 12° F. when they reach 90° F., or before, or they will reach a temperature of over 100° F. By referring to the 90° column we find the number 12 in the row representing 10 per cent of sugar. This shows that the fermenting must will reach 90° F. when it still has 10 per cent of sugar, and as indicated in that line requires to be cooled 12° F., as already determined.

This shows that we can tell the amount of cooling necessary from the temperature and sugar tests at any time, either when the grapes are first crushed or when they are fermenting. The later the determination is made the less liable to error it will be. Any calculation made before fermentation will be only approximate, but made when the temperature is near the maximum it will be quite exact enough.

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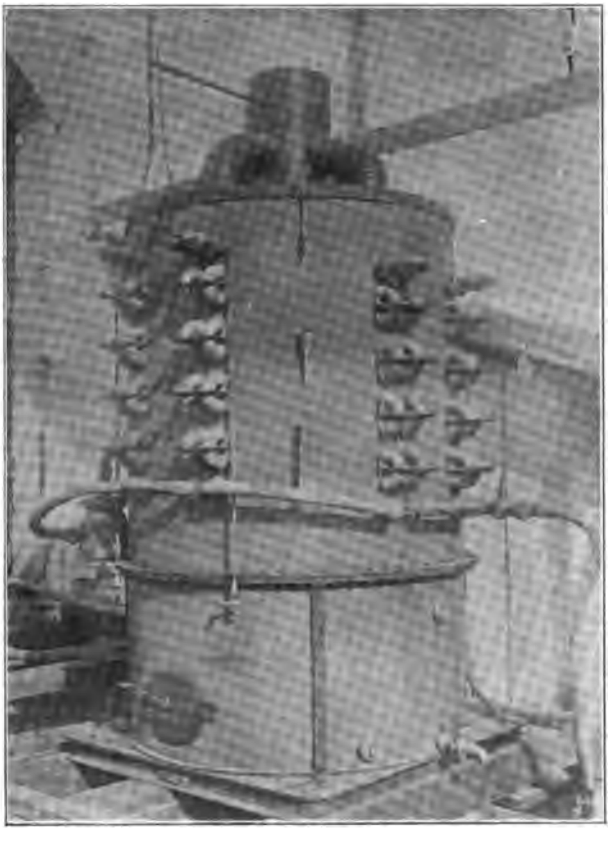
A New Method of Making Dry Red Wine.

By FREDERIC T. BIOLETTI.



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A NEW METHOD OF MAKING DRY RED WINE.

In Bulletin No. 167 of this Station, discussing various means of improving the quality of dry wines made in hot countries, the conclusion was reached that the method which offered the best hope of attaining the end in view was that by which the requisite tannin and color were extracted by heat before fermentation. The method, as outlined there, is as follows:

"1. Heating the crushed grapes to a temperature and for a time sufficient to extract the necessary color, tannin, and body.

"2. Immediate separation of the must, and cooling to 85° F.

"3. Immediate fermentation of the must at a temperature not exceeding 90° F."

The bulletin further states: "The present status of the method is this:

"1. It has been shown, both in California and in France, that it is possible, when working with small quantities, to attain the object in view by this method.

"2. The method has been used with success in France in the whole output of a cellar manufacturing 75,000 gallons of wine in a season."

Experiments, made on a sufficiently large scale during the past vintage, have further demonstrated that the method is perfectly adapted to large-scale practice in California, and that it is possible by this means to produce a wine of excellent quality where it had been found impracticable to do so by the old methods. These experiments indicate strongly, moreover, that it is not only possible to make good dry red wine by this means, but that, where the climate is hot during the vintage, it is the simplest and most economical method of attaining the end in view when working on a large industrial scale.

This is not intended to mean that the use of this method alone is all that is necessary to improve the quality of the dry wines of our hotter regions, but that, together with proper attention to the ordinary details of wine-making, the proper use of cooling machines, and perhaps of pure yeast, we have a means by which we can be sure every year of making the best wine that the grapes available are capable of producing. In a cellar properly arranged for the purpose, all this can be accomplished at a cost so little in excess of the cost of the usual methods of manufacture that the loss which occurs in practically every large winery in the State, of a few vats of wine by bad or incomplete fermenation, far more than counterbalances it.

The experiments show further that, where the grapes are well ripened and in fair condition, all that is necessary in our hot valleys, for the production of good, sound wine, is the use of cooling devices in the fermentation, and attention to proper sterilization of vats and casks.

In order to give a clearer idea of how the method could be carried out on a large scale in a winery built for the purpose, a plan of such a winery has been given with enough detail to exemplify all parts of the process and to enable any one to calculate the cost of operation.

While the main object of the experiments was to test the capabilities of the method referred to, other methods and other matters of interest in the fermentation of wine were investigated both for comparison and for the purpose of devising the best way of carrying out the method in practice.

The main lines of investigation were the following:

1. Extraction of color and tannin by artificial heating.
2. Control of the temperature of fermentation by means of a cooling machine.
3. The use of pure and selected yeast.
4. The use of sulfurous acid in controlling the temperature of fermenting grapes.
5. The making of wine from incompletely ripe grapes.

In order to make the bearing of the experiments clear, a detailed account of the method used is necessary. Reference to pages 19 to 26 of Bulletin No. 167 will make the objects of the principal experiment clear. There, will be found a discussion of the effects of high temperatures on the fermentation of wine, and an account of the preliminary laboratory experiments which led to the devising of the method used in the larger winery experiments this year.

It will be seen, from the reference given, that high temperatures have beneficial and necessary, as well as injurious, effects in the production of dry red wine, and the experiments detailed in this bulletin show that a practical method has been devised which will "combine the beneficial effects of heat in the extraction of color, tannin, and body with those of cool fermentation in producing bouquet, freshness, and maximum amount of alcohol." These experiments also indicate very strongly that by use of the method recommended we are certain to produce a sound wine from any grapes in fair condition, however hot the season; and that, even when the grapes are inferior by reason of mold, drying up, etc., much better wine can be made than by any of the usual methods.

The principal merit of the method, therefore, is the *certainty* it gives that *every vat* of wine will be *perfectly sound every year.*

DESCRIPTION OF METHOD.

Crushing.—The grapes were taken as they came to the winery in the usual way, passed through the ordinary crusher and stemmer, and pumped by means of a must-pump through the regular must-line into 1,500-gallon vats.

As the crushed grapes came into the vat a small amount of potassium meta-bisulfite dissolved in water was added gradually, in such a way as to distribute it equally throughout the vat. The amount used varied from .2 to .4 per mil. of the weight of the grapes, that is to say, from 6 to 12 ounces per ton.

The sulfite was added to paralyze temporarily the action of the molds, bacteria, and yeast present, and to facilitate the solution of the color. Another important use of the sulfite is to prevent too much oxidation during the heating, and so to avoid the "rancido" taste which might be acquired if the grapes were allowed to remain hot too long or if they were heated too high.

Preparation of Vats.—The vats were cleaned with hot water and soda and then swabbed with a 3% solution of commercial sulfuric acid to partially disinfect them. The acid solution was left on the walls of the vats for a few hours and then rinsed off with water.

Straining.—At the bottom of each vat was placed a strainer extending from the bunghole across the whole bottom to the opposite side. The form of strainer used is shown in Fig. 1. It consisted of an inverted rectangular trough closed at one end and having a top consisting of a solid board, and sides consisting of slats made with beveled edges like the slats of a press basket.

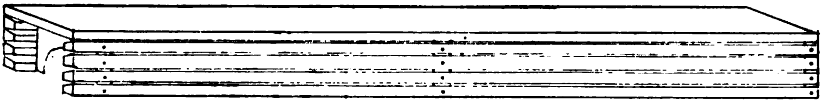

FIG. 1. Strainer for bottom of Fermenting Vat.

These strainers were found to be not sufficiently effective, owing to the very thorough way in which the grapes were broken up by the method of handling. In practice it would be necessary to have a more efficient method of straining, or to adopt a method of crushing the grapes and conveying them to the vats, which would not result in such complete maceration.

The former, *i. e.*, the use of a more efficient straining device, would be preferable, as it is very desirable to have the grape-pulp thoroughly disintegrated in order to facilitate the extraction, which takes place the more rapidly the more completely the grapes are crushed.

As soon as the vat was full of crushed grapes the must was allowed to run off the skins into another vat. It was found possible to run off a volume of must equal to only one half of the total volume of the crushed grapes. With a better arrangement for straining, a volume equal to two-thirds could be run off, which would much facilitate the subsequent operations.

Heating.—As soon as the must was separated it was passed through the heater and back into the vat containing the strained skins. The must was heated to from 140° to 150° F., and as the grapes were much cooler they remained at the bottom, and it was found very difficult to mix the two when the hot must was pumped on to the top. This difficulty was overcome in great measure by attaching the hose, bringing the must from the heater, to a faucet in the bottom of the vat. By this means the hot must was forced through the cool grapes, and a thorough stirring at the end equalized the temperature in the whole vat.

The Heater.—The must was heated by means of a "must-heater" constructed by Gomot, of Nimes, France. This machine is essentially a large tubular pasteurizer, the exterior of which is shown in the figure on the cover.

The height of the boiler is 6 feet 10 inches from the ground to the top, and the chimney is 2 feet 5 inches more. Its diameter is 4 feet 3½ inches, and the tube connections protrude a few inches more on all sides.

It consists of a system of copper tubes, through which the wine runs, and a boiler surrounding them, which is heated by a fire in the firebox below, from which the heat passes by four flues into the chimney. When used in the way intended by the manufacturer, the boiler is filled with water. In our experiments, acting on the suggestion of Mr. Meakin, we found it more convenient to simply admit steam into the boiler and to dispense with both water and fire.

There are eighty straight copper tubes joined by unions outside the boiler, as shown in the figure. These tubes are each 3 feet 10 inches long and 1½ inches in diameter, and are easily cleaned by removing the couplings, for which purpose the arrangement is very simple. In our experiments, there was no deposit whatever in the tubes, and after passing water through the machine they were found perfectly clean.

The machine is furnished with a strainer, which prevents seeds and skins passing into the tubes. This strainer must be opened and cleaned occasionally, and is so constructed that this is easily done. Four thermometers are placed in various parts of the heater, which enable the operator to control the heating perfectly. There is one thermometer in the boiler, one at the entrance of the must, one at the exit, and one halfway between these. By carefully watching these thermometers and manipulating the steam valve, the heating can be regulated in a few minutes to any degree required. The heating remains very constant so long as the steam pressure does not vary, and providing the supply of must is regular.

A hand pump can not be used to supply the must, as the output is too irregular. It is necessary to have a pump that will give a constant stream of uniform volume. For this purpose a steam pump would be excellent, as its output can be regulated to any desired rate. For the experiments a gasoline motor pump especially constructed by Gomot for the purpose was used. The rate of pumping could be varied by a simple arrangement to from 375 to 1,500 gallons per hour. Such control of the rate of pumping is necessary, as the heating depends on the rate with which the must passes through the machine, as well as upon the amount and pressure of the steam admitted.

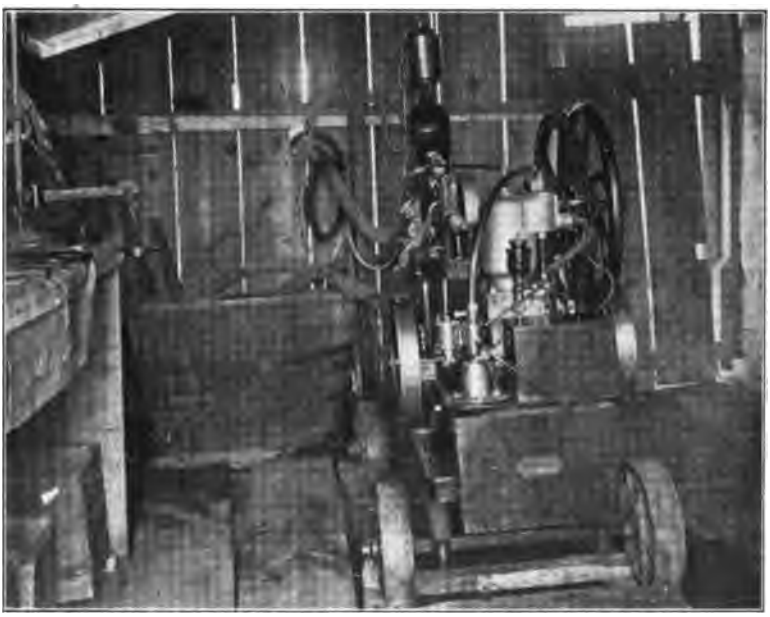

FIG. 2. Gomot Motor Pump.

Capacity of Heater.—It was found that the machine would heat 1,000 gallons of must per hour from 75° to 150° F. when the temperature of the boiler was kept at 185° F. The steam pressure during the trials was 80 pounds. There was no pressure in the boiler of the heater, as it has an opening above.

Heating the must to 150° F. is about what would be found convenient in practice if the temperature of the crushed grapes was 75° F. and two-thirds of their volume of must was passed through the heater at 150° F. This is just about what is necessary to give the desired results.

Extraction.—When the mass of crushed grapes has reached the desired temperature, it is left, with occasional stirrings (every three or four hours), until the required color and tannin have been extracted by the must.

It has been shown by the experiments detailed on page 22 of Bulletin No. 167 that the color and tannin are extracted *pari passu*, so that by periodical observations of the color it is possible to note the progress of extraction.

Salleron's Vino-Colorimeter.—For this purpose a Salleron vino-colorimeter is extremely useful. A very full description of the nature and use of this instrument was given by Prof. E. W. Hilgard in the Viticultural Report for the seasons 1885 and 1886, on pages 23 and 26. So far, this is the best and most practical means which has come into general use for measuring the color of wine, and as some quick and reliable means of determining the color during the process of extraction is necessary for the proper carrying out of this method, a short description of the instrument is given here.

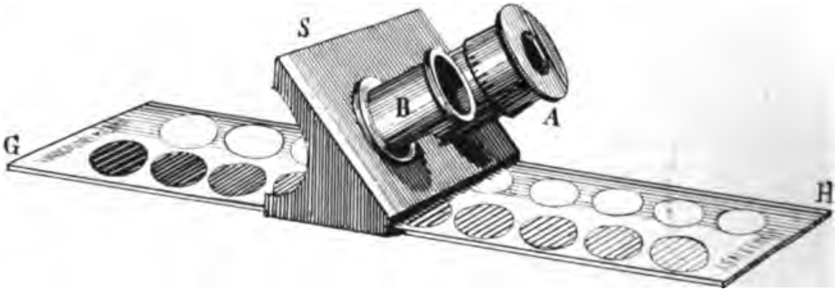

FIG. 3. Salleron's Vino-Colorimeter.

The colors of wines differ in two respects. They may differ in tint (that is to say, the kind or nature of the color may differ), and they may differ in intensity (that is, the depth or amount of color may differ). In order, therefore, to measure the color of a wine and to compare it with the color of another wine we must measure both its tint and its intensity. Both these measurements may be made with the Salleron vino-colorimeter.

For the determination of the tint a scale (Fig. 3, G-H) is furnished, consisting of a piece of cardboard on which are gummed small disks of silk which represent all the tints usually found in dry red wines. At the top of the scale is a disk marked VR (violet-red), which is the tint of a new wine made from a good coloring grape with full acidity, such as the Petite Sirah or Cabernet. At the bottom of the scale is a disk marked 3R (third red), which is the tint of an inferior coloring grape with low acidity, such as Grenache or Mission. Between these extremes are eight other disks representing the intermediate tints which red wines may have. Altogether there are ten disks representing ten tints, which are marked as indicated in Fig. 4. Each tint differs from the one above it in having a slightly greater admixture of yellow.

Wines of claret type should not fall below the 5VR, while those of Burgundy type may go to the bottom of the scale. Ports contain more yellow even than the 3R, and can not be measured satisfactorily by this scale. As wines become older the tint gradually becomes yellower, so that a wine which when made corresponds to the VR disk may fall to the 5VR disk when it is a year old.

All the disks are made with the same intensity of color, so that in order to compare wines with them it is necessary to reduce the intensity of color of the wines to that of the disks. This is done by varying the thickness of wine through which we look. If we observe the color of a wine by looking through it in a glass three inches in diameter it will appear to be twice as dark or intense as if we look through it in a glass of only one and one-half inches diameter. This principle is made use of, both to bring the wine to the standard intensity which makes it possible to compare its tint, and also to measure the intensity itself.

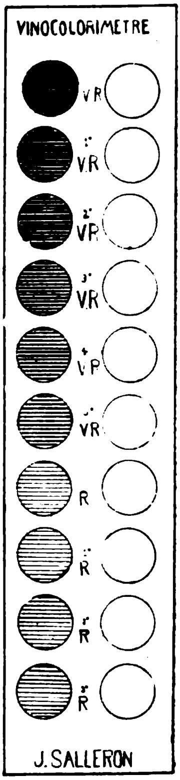

FIG. 4.
Scale of Tints.

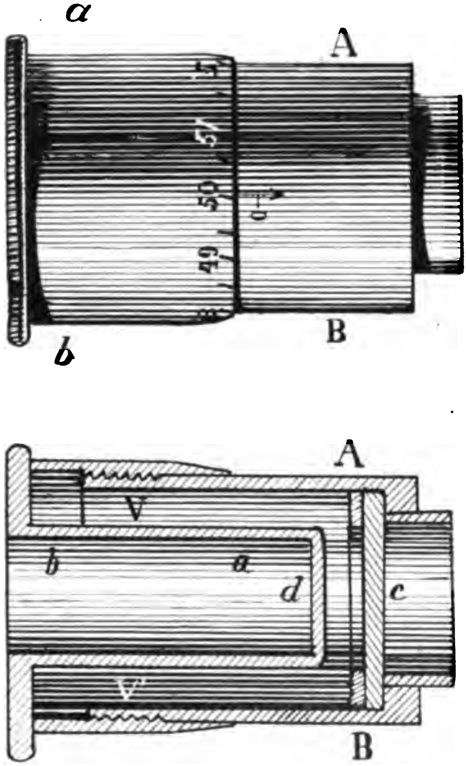

FIG. 5. Construction of Salleron's Vino-Colorimeter.

To use the instrument a small portion of the wine is placed in the receptacle V (Fig. 5), and the screw cap *ab* moved up or down until the thickness of wine between the glass disks *c* and *d* through which we look gives us an intensity equal to that of the disks. The scale is then moved back and forth until the proper tint is found.

We now have all the data for describing the exact color of the wine. The tint is given by the name of the disk used and the intensity by the distance of *d* from *c*, which is read off from the scale on the outside of the cap *ab* at the point marked on AB with an arrow.

If we get such a reading as 3VR, 160 it means that the *tint* of the wine is third violet red and the *standard intensity* is obtained by looking through 160 hundredths of a millimeter of the wine. If we get the reading 80 on the scale it will show that only half as much wine is necessary to give the standard intensity and, therefore, that the wine is twice as dark or intensely colored as in the first case. The smaller the reading on the scale, therefore, the more deeply colored the wine.

To overcome this inconvenience Professor Hilgard has adopted a scale of which the notation is inversely proportionate to the thickness of the wine necessary to give the standard tint, and of which, therefore, the numbers given are directly proportionate to the intensity of color. For this purpose he has taken a wine which required 40 hundredths of a millimeter to give the standard intensity as an arbitrary standard, which he calls 100. A wine with half this amount of color would then, with this scale, have an intensity of 50. The number is obtained by dividing 4,000 by the reading of the scale. This would give us, then, for the first example an intensity of 4000÷160, or 25, and for the second 4000÷80, or 50.

If R represents the reading on the scale, then 4000 ÷ R = Intensity by Professor Hilgard's scale.

Comparison of Scales.

Salleron Scale.		Hilgard Scale.
40	=	100
80	=	50
160	=	25, etc.

The Hilgard scale has the great advantage of giving a clear idea of the intensity of color in a wine without the need of making any mental calculations, for if the color of one wine is represented by a number three times as large as that representing the color of another we know that the first has three times as much color as the latter.

Professor Hilgard's notation has been used in the account of experiment work detailed later.

In the absence of any recognized standard of intensity for the color of wines it is difficult to say what the proper degree of color is. In order to give some idea of what the numbers of Professor Hilgard's scale indicate in practice, it may be said that a wine measuring 15 in intensity would be considered sufficiently dark for an ordinary table wine. Any wine which falls below 10 is too light in color, while anything over 20 may be considered darker than is necessary. These figures have reference to the United States. In Europe the popular taste does not require quite so much color.

A young wine should contain more color than these figures indicate, as a certain proportion of the color always drops during aging. This loss of color is most rapid during the first two months after fermentation. It becomes less rapid later, until after four months the loss is very slow. The amount of loss varies very much with different wines, and with different methods of handling, but a Zinfandel to have 15 of color when it is two years old should have at least 35 or 40 directly after drawing off from the fermenting vat, and, to preserve its color even so well as this, it must have full acidity and must not be aged too quickly by frequent racking or keeping in small casks or warm cellars.

The following table is appended to show the actual loss of color found by observation. The tests were made with experiment wines fermented at the Station cellar, and were all made in small quantities and kept in casks of from 10 to 20 gallons. In larger quantities the loss of color would be slower, and the depth of color indicated for four months probably corresponds to what would be found in practice in a wine of the same character at the end of eighteen months or two years:

TABLE I.

Loss of Color during Aging of Wine.

Number of Wines Examined.	Color.								
	At Pressing.	1 Month.		2 Months.		3 Months.		4 Months.	
			Loss.		*Loss.*		*Loss.*		*Loss.*
Four	330	191	42.1%	117	64.5%	114	65.4%	101	69.4%
Six	140	95	32.2%	91	35.0%	68	51.4%	59	56.8%
Five	85	50	41.2%	36	57.6%	34	60.0%	27	68.2%
Seven	35	25	28.6%	16	54.3%	15	57.1%	13	62.9%
Five	23	15	34.8%	11	52.2%	10	56.5%	9	60.9%
Three	13	9	30.7%	9	30.7%	7	46.2%	5	61.5%
Average of color remaining	100		65.1%		50.9%		43.9%		36.5%
Average loss of original color for each month	....		34.9%		14.2%		7.0%		7.4%

It will be seen by examining the table that approximately the same proportion of the color is lost whatever the original color in the wine, so that it is possible to foretell within very close limits what the color of a wine will be at the end of a certain time when kept under certain conditions. This applies only to wines of which the coloring matter is normal. Wines made from such grapes as Lenoir, Grenache, Trousseau, or from partially dried or moldy grapes, lose their color more quickly.

It may be said, then, that wines kept in very small casks lose about one-third of their color during the first month, about one-half during the first two months, and nearly two-thirds of their color during the first four months after pressing.

The loss at first is much more rapid in the very deeply colored wines than in those more lightly colored, as is shown by the curves in Fig. 6.

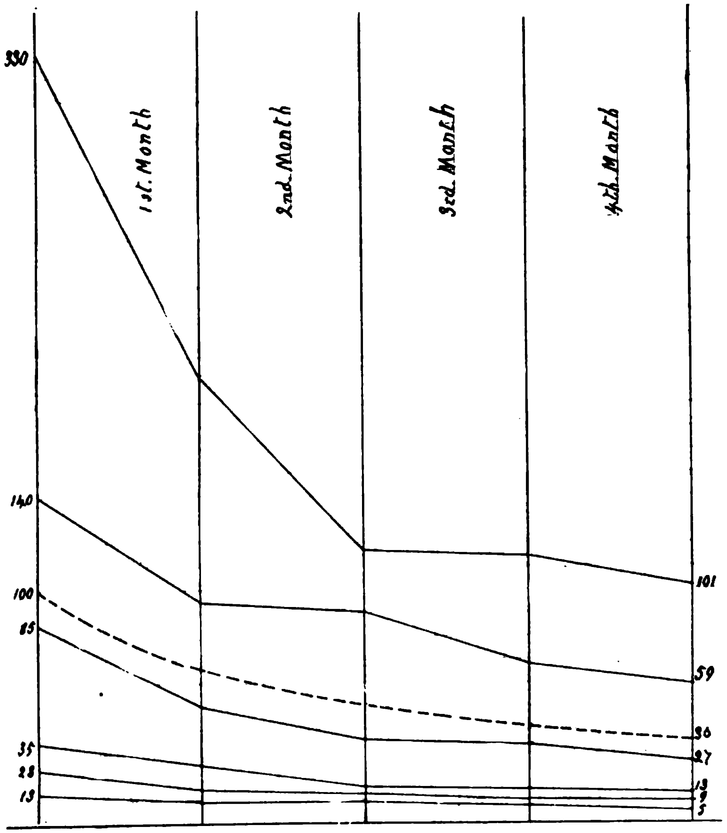

FIG. 6. Loss of Color in Red Wines during the First Four Months.

The numbers on the right show the color at pressing; those on the left at four months. The dotted curve shows the average loss calculated from observations on thirty wines.

Cooling.—As soon as the extraction of the skins has proceeded far enough, as indicated by the reading of the colorimeter, the must, now containing tannin and color, is drawn off and cooled to 80° or 85° F. This was done in the experiments by means of the cooling machine described in Bulletin No. 174. As the must is hot (125° F.) and the temperature has to be lowered only to 80° or 85° F., the cooling takes place very easily and rapidly with the cooler used. The hot must runs off very freely, as the pulp cells of the grapes have all been thoroughly heated and have lost the power of retaining the juice possessed by the cells of fresh grapes. A certain amount of juice remains, however, in the skin, most of which can be recovered by pressing, as is ordinarily done with fermented grapes. It would be better to extract this juice by some diffusion process, but so far no satisfactory method of doing this has been devised. In the experiments, only the must which ran off without pressing was used, but it would be very desirable to obtain that remaining in the skins, as it contains more color than that in the free run. A continuous press would be excellent for this purpose, as the maceration of the pomace which occurs with such presses would not have the bad effect it has when pressing fermented pomace, because the extra amount of solid matter would be to a great extent precipitated during fermentation.

As soon as the must is cooled and run into fermenting vats, any correction which it needs, such as the addition of acid or water, should be made. At the same time a starter of yeast should be used, preferably of tested pure yeast.

Pure Yeast.—In the experiments, a pure Champagne yeast was used. This yeast had been thoroughly tested and found capable of fermenting out very sweet musts and producing a good wine. The same yeast was used in all the experiments and was found to give good results with both white and red wines.

Method of Using the Pure Yeast.—A method was devised for keeping a supply of pure yeast on hand for the various fermentations, which was found very simple and convenient. As the method is of general application and could be used for the same purpose with the ordinary methods of wine-making, it is described here.

The method adopted was as follows: Starting with a 4-ounce flask, the pure yeast was increased by pouring it into a large flask containing one gallon of must which had just been cooled to 90° F. after sterilizing by boiling. Three days later, this gallon of must was fermenting well and contained a large amount of active yeast. In the meanwhile 25 gallons of must, obtained from clean, sound grapes, had been cleared of its sediment and yeast by settling with sulfurous acid. This was done by adding 1 ounce of potassium meta-bisulfite dissolved in one pint of water to 25 gallons of must. This had the effect of preventing fermentation until all sediment, including the molds and yeast, in the must had settled. In twenty-four hours, must treated in this way was perfectly bright and was racked off into a clean cask which had been thoroughly sterilized by steaming. Must treated in this way is practically free from all fermentative organisms. Five gallons of this clear must were then freed from the sulfurous acid by boiling and placed in a shallow tub which had been thoroughly cleaned and sterilized with boiling water. As soon as the must in the tub had cooled to 90° F., the gallon of yeast in the flask was added and the whole thoroughly aërated by dipping up the must with a gallon measure and pouring it through the air back into the tub. As soon as fermentation was well under way (twenty-four hours), 2½ gallons of the clear must were added without previous boiling. More than this should not be added for fear of the arrest of the fermentation which might occur if too much of the must containing sulfite were added at once. The next day, 5 gallons more of the clear sulfited-must were added. It was safe to add more this time as the yeast was becoming used to the sulfurous acid. Twenty-four hours later the remaining 12½ gallons of the sulfited-must were added.

In this way, at the end of six days, 25 gallons of must containing pure yeast were obtained practically free from molds, bacteria, or wild yeast. In order to have a maximum amount of vigorous yeast in the must it should be thoroughly aërated several times every day, and fermented in a low, wide tub.

As soon as a stock of pure yeast is obtained in this way it can be kept up simply by replacing the yeast taken out with an equal quantity of clear sulfited-must prepared in the way described. During the vintage it is not necessary to crush and press grapes specially for this purpose, but the must can be taken directly from the vats or casks, care being taken to sulfite the must as soon as it is separated from the grapes before the slightest fermentation has commenced.

A stock of 25 gallons is sufficient for the fermentation of 2,000 gallons per day. Twenty gallons may be taken from the pure yeast tub every day and replaced with sulfited-must, and if the temperature is kept above 80° F. and the must is not too sweet (not over 22% B.) and sufficient aëration is given, the amount of yeast in the must will not diminish.

Every care should be given to prevent contamination of the yeast. The yeast tub should be kept covered with a clean cloth and should be placed in a room separate from the fermenting vats. All tubs, buckets, casks, hose, etc., used in the production of the yeast should be thoroughly sterilized with boiling water and not used for other purposes.

While it is not pretended that by these means, however carefully carried out, we are sure to obtain an absolutely pure culture of yeast, in the sense that it does not contain a single germ or cell of anything but the yeast we start with, it was found that, for practical purposes, it preserves the culture pure during the whole vintage. As we add the yeast to grapes containing spores and germs of many kinds or to imperfectly sterilized must, the few contaminating spores that may get into our pure yeast are quite harmless. This is true, however, only if we exercise well the precautions indicated. If we allow vinegar flies to get at our yeast vats, or draw off the yeast with hoses used for racking wine or must, the yeast will quickly become badly contaminated.

Fermentation.—After the red must has been cooled and the yeast added, fermentation will start immediately. Within twenty-four hours the temperature will rise to 90° or 95° F., depending on the outside temperature and the size of the vat. Before it reaches 95° F. the fermenting must is passed through the cooler and reduced to 80° F. If the weather is not very hot, the vats do not contain more than from 1,000 to 3,000 gallons, and the original density of the must does not exceed 22% to 23% Balling, this cooling will be sufficient. Usually, however, if we are to have a cool fermentation, another cooling later will be necessary. In the experiments two coolings were always given, and wines containing over 14% of alcohol and in one case over 15% fermented out perfectly dry.

After Fermentation.—With musts containing no more than 22% Balling, it is possible to obtain perfectly dry wines in four to five days in the fermenting vats. To insure this, a certain amount of aëration should be given at each cooling. This is accomplished simply by allowing the stream of cooled must to fall through the air a distance of three or four feet into the vat. The must will in this way carry down enough air to keep the yeast working vigorously. This aëration will at the same time get rid of any excess of sulfurous acid which may be present. In the experiment wines, this was accomplished so perfectly that only the faintest traces of the acid were found in the finished wines, an amount less than one-fiftieth of that allowed in French wines imported into the United States.

More aëration than is necessary for the completion of the fermentation should be avoided, on account of its effect on the color, which is diminished in quantity and injured in quality by excessive exposure to the oxygen of the air.

With musts containing over 24% Balling it will usually be found impossible to ferment the wine perfectly dry in the four days, but it is inadvisable to leave it in the open fermenting vats any longer than this. At the end of four days, whatever the strength of the original must, the fermentation will be very slow. If the temperature, however, has never exceeded 95° F. it will not have ceased entirely, and every effort should be made to keep it going until the wine is perfectly dry. It is a capital mistake to allow the fermentation to stop and the yeast to settle while the wine still contains .5%, 1%, or even 2% of sugar, as is often done in the hope that the fermentation will recommence in the spring and eliminate this sugar.

At the end of four days in the open vat the wine should be transferred to a storage cask however much sugar it still contains. This transfer should be made with thorough aëration, and the receiving cask should not be sulfured. The wine should run in a stream which falls through the air into the pump-tub, or well, and should enter the storage cask through the upper bunghole so that it will fall through the air in the cask, unless some other means is adopted for supplying the needed oxygen.

This aëration will reinvigorate the yeast and will usually be sufficient to keep the fermentation going until the wine is dry. The wine should be watched, however, and, if in seven days it is not dry, it should be aërated again by running it off from the bottom of the cask and pumping it back into the same cask. In the experiments this was found sufficient, even in cases where the resulting wine showed over 15% of alcohol, to bring the wine to dryness in three weeks from the time the grapes were crushed.

By this means the dangerous bacterial fermentations, which so often injure wines, even when they do not spoil them, during the one or two months following the vintage, will be avoided. The presence of a small quantity of sugar in the wine can not be detected by means of the ordinary saccharometer or mustimeter used by cellermen. The saccharometer may descend to the 0 mark, or even considerably below in wines which contain over 1% of sugar. This is especially true of highly alcoholic wines, which are the most troublesome to get dry. The taste of the wine-maker is the only practical means of determining the presence of a dangerous residue of sugar in the wine.

So long as a taste of sweetness can be perceived in the wine by a practiced taster, means should be adopted to keep the fermentation going. For this purpose, usually all that is necessary is an occasional aëration and stirring up of the yeast, as already described. Prompt action, however, is necessary. The wine should never be allowed to get cold before it is quite dry. If the wine is placed in puncheons or other small casks it is very useful, if not quite necessary, to keep it in a room where the temperature does not fall below 70° F. If it is placed in large casks (1,000 to 5,000 gallons or larger), it will retain its heat for a sufficient time to become perfectly dry if the needed aëration is given.

If, even with these measures properly carried out, the wine still remains sweet, it means, provided the grapes used were not excessively moldy, that the original must contained more sugar than it is possible for the yeast to eliminate. If the must contains more than 28% Balling, as will sometimes happen, especially when partially dried grapes are present, there is usually no possibility of fermenting it dry. In this case, the sugar may be eliminated by blending with a wine containing less than 12% of alcohol. This blending, however, must be done promptly, before either wine has become cold and before the wine containing sugar has become injured by bacterial fermentation. If a wine is not perfectly dry within seven days after being transferred from the fermenting vat to the storage cask, an alcohol determination should be made. If there is more than a mere trace of sugar and the alcohol exceeds 14½%, the wine should be blended immediately with a weaker wine and aërated again.

First Racking.—While, so long as any sugar remains, our efforts should be directed toward keeping the yeast vigorous and suspended in the wine, we should use means to accomplish the opposite results as soon as the sugar has all disappeared and the wine is perfectly dry.

The function of the yeast is to change the sugar of the must into the alcohol of the wine. As soon as this is effected the wine should be freed from the yeast as soon as possible. If the fermentation has been conducted successfully, the yeast will commence to deposit immediately and the wine will be comparatively clear within two or three weeks after it has become dry. The first racking, then, should take place at this time and, as there is no need for further fermentation, the casks into which the wine is racked should be sulfured. This should be done with both red and white wines. The sulfur will remove a little of the color in the former case, but some of this will return as the sulfurous acid disappears, and the color remaining will be much more stable. Properly sulfured red wines will show more color at the end of six months than similar wines which have not been sulfured.

It is neither necessary nor advisable to wait until the wine is perfectly clear before making the first racking. All wines made by commercial methods contain a few bacteria and many of them a great many, and even when wines taste dry there is often a trace of sugar left which is sufficient to serve as nourishment for the bacteria. It is very desirable, therefore, to put the wine in such a condition that the bacteria will be deposited and the wine cleared as soon as possible. This is accomplished by racking without aëration, which eliminates the yeast and bacteria in the thick lees, and by sulfuring and cooling, which stop the action of the floating bacteria and cause them to be deposited.

After the first racking, or before, if the wine is perfectly dry to the taste, the cellar should be kept as cool as possible and the wine protected as much as possible from the air, in order to promote the settling of all the fine lees and hasten the perfect clearing of the wine.

EXPERIMENTS: RED WINE.

I. *Over-ripe Grapes; Extraction by Heat; Use of Cooler; Pure Yeast.*—On August 21st, at 3 P. M., about twelve tons of Zinfandel grapes were passed through the crusher and stemmer and pumped by means of a must pump into a vat furnished with a strainer. The grapes were very ripe, with a large proportion of shriveled berries, and some quite dry. There were abundant signs of Mildew (Oidium) and some Black Mold (Aspergillus). The must showed 26% Balling and .55% of acid immediately after crushing and before the sugar from the dried grapes had diffused out into the must. There was a very little second crop present.

Before placing the grapes in the vats, the latter were thoroughly washed and then swabbed with a 3% solution of sulfuric acid, which was left on the wood for several hours and then rinsed off with water. This treatment was given to all the vats used in the experiments.

As soon as the vat was full, the must was drawn off and passed through the Gomot heater, from which it passed with a temperature of 140° F. back on to the skins in the original vat. This was continued with occasional stirring of the grapes until the contents of the vat had reached a temperature of 112° F. Before passing the must through the heater, 3.75 pounds of potassium meta-bisulfite were added to it to prevent the oxidizing effect of the air on the heated grapes.

At 7 A. M. of the next day, August 22d, the must in the vat was red, but not deeply colored. The color was 2VR, 49.4. (See page 10.) The must at this time showed 27% Balling, owing to the diffusion of the sugar from the dried grapes into the must. The acid was .65% and the tannin .32%. The tannin was sufficiently high, but in order to increase the color it was decided to heat the vat again.

At 9 A. M. the must was drawn off again and passed through the heater at 150° to 158° F. and back on to the skins until the whole vat showed 133° F.

At 10 A. M. the color had increased to 2VR, 65.6, and the tannin to .352%.

At 4 P. M. of the same day the red must was run through the cooler, reduced in temperature to 84° F., and a starter of 15 gallons of Champagne yeast (see p. 13) added. Later, 250 gallons of water and 5 pounds of citric acid were added to the 1,700 gallons of must.

The progress of the fermentation is shown below:

		Sugar.	Temperature.
Aug. 22,	6:00 P. M.	27% B.	84° F.
Aug. 23,	6:00 A. M., fermenting well	25	85
	12:00 M., water and acid added.		
	1:00 P. M.	22	84
	Color, 3VR, 58; Acid, .66%; Tannin, .35%.		
	5:00 P. M., passed through cooler	19	90
	7:00 P. M.	19	84
Aug. 24,	7:00 A. M., cooled to 84° F.	16	92
	Color, 1VR, 41.2.		
	12:00 M.	13½	87
	5:00 P. M.	12	89
Aug. 25,	7:00 A. M., cooled to 90°	7	96
	Color, 3VR, 27.5.		
	12:00 M.	5.2	90
	6:00 P. M.	4.5	89
Aug. 26,	6:00 A. M.	2.5	93
	12:00 M.	1.5	93
	Racked into storage vat.		
Aug. 27,	Nearly dry.		

On September 1st the wine showed 13.5% of alcohol and the color was 4VR, 26.3. On September 7th it was nearly clear, and was racked into puncheons, and in a few days was quite dry and clear.

This experiment shows that heating the grapes to 112° F. is not sufficient to extract the maximum amount of color of ripe Zinfandel, even though the grapes are kept hot for fifteen hours.

The fermenting wine was cooled three times. This was necessary because the regular cooling machine was not ready for use and a temporary and less efficient device had to be used. The fermenting wine was lowered 20° F. by the three coolings. This could have been done, as was proved later, by one cooling of two hours at the rate of 750 gallons per hour with the form of cooling machine finally adopted, or by two coolings of one hour at the same rate. The effect on the fermentation, however, was the same, and it continued without interruption until the wine was dry at six days, with 13.5% of alcohol. It is instructive to compare this result with Experiment III, where the cooling was intentionally less complete. The wine of Experiment III required thirty days to become dry, though the alcohol in the wine was 1% less than in the wine of this experiment.

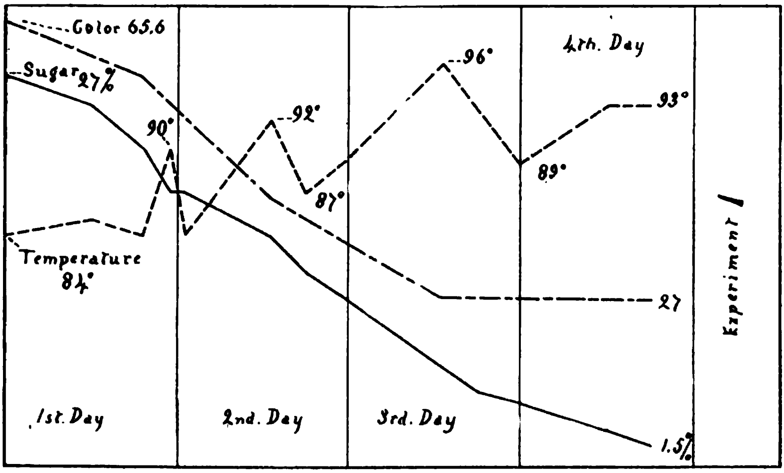

FIG. 7. Color, Sugar, and Temperature Changes of Experiment I.

An examination of Fig. 7 shows that the curve representing the diminution of color during fermentation is for the first three days very nearly parallel to that representing the diminution of the sugar-content. This probably indicates that the part of the color insoluble in alcohol is deposited in the same ratio as the alcohol is produced by the fermentation of the sugar. This rapid fall of the color ceases on the fourth day, the color which remains at this time being soluble in alcohol, and the further production of alcohol has little or no effect on it. The number 27 representing the color at the end of the fourth day probably indicates the whole amount of the original color in the grapes which is capable of remaining dissolved in the fermented wine. Whether all of this could have been extracted by the ordinary methods of fermentation is not shown by the experiment, but a comparison with the results of Experiment III indicates that it could not. The wine of the latter experiment, made from grapes similar to those used in Experiment I, had only 18 of color at the end of the fermentation. With regard to the stability of the color the comparison is even more strikingly in favor of the new method. At the end of three months the color of the wine of Experiment I was practically the same as when the fermentation had finished at four days, while the wine of Experiment III had lost 28% of its color.

The broken line in Fig. 7 shows the temperature changes observed during the fermentation. A drop in temperature occurred four times. The first, a slight drop, was due to the addition of cold water used to dilute the must. The other three drops are the effects of the coolings which were given when the fermenting wine reached 90°, 92°, and 96°, respectively. A point of interest in this curve is that the abrupt changes in temperature had practically no effect on the rapidity of fermentation, as is shown by the even curve representing the disappearance of sugar. A slight irregularity of the sugar curve may be noticed opposite each jog representing a cooling on the temperature curve, but the irregularity is so slight that it is of no practical importance. This is shown equally in Experiment IX (see Fig. 10, page 25), where coolings of 13° F. and 14° F. show hardly any appreciable effect on the rate of fermentation. This lack of apparent influence of the cooling on the rate of fermentation is probably due to the fact that each cooling was accompanied by an aëration which invigorated the yeast and counteracted the retarding effect of the lower temperature.

II. *Under-ripe Grapes; Use of Cooler; Pure Yeast.*—On August 25th about twelve tons of Zinfandel grapes were crushed, stemmed, and pumped into a fermenting vat, a starter of pure Champagne yeast being added as the grapes came into the vat. The grapes were poorly colored and not thoroughly mature. They showed 22.7% Balling and .66% of acid. The record of the fermentation is as follows:

	Sugar.	Temperature.
Aug. 25, 10:00 A. M.	22.7% B.	71° F.
7:00 P. M.	22.2	74
Aug. 26, 7:00 A. M., fermenting well	22.4	78
12:00 M., fermenting well	20.4	78
7:00 P. M., fermenting well	19.2	88
Aug. 27, 7:00 A. M., cooled to 90° F.	6.0	96
12:00 M.	5.5	90
7:00 P. M.	4.0	92
Aug. 28, 7:00 A. M., racked into storage vat	1.0	94

Aug. 29, Dry.
Sept. 7, The wine was still cloudy, but was racked into puncheons.

This experiment illustrates the fact that even when the grapes are gathered incompletely mature, the temperature of the fermentation must be controlled in a hot climate if we are to produce a dry wine; and it also shows that we can not expect to produce wine of good quality from unripe grapes, as will be seen by comparing the quality of the various experiment wines as given on page 27.

The checking of the fermentation at the time of cooling is more perceptible in this fermentation than in any of the others. In this case, as in that of the last cooling in Experiment IX, the checking at cooling is probably merely a coincidence and due in reality to the large amount of alcohol present at that stage of the fermentation. The upward course of the temperature curve (Fig. 8) during the first day without any corresponding decrease of sugar is due undoubtedly simply to errors of observation. It is extremely difficult to take an average sample for either sugar or temperature determination in a vat of crushed grapes immediately after filling. Later, after fermentation has commenced and the grapes have been well stirred, the observations are much less liable to error. The average temperature of this vat at the beginning was undoubtedly higher than 71° F. The same peculiarity is seen in the curves of Fig. 9.

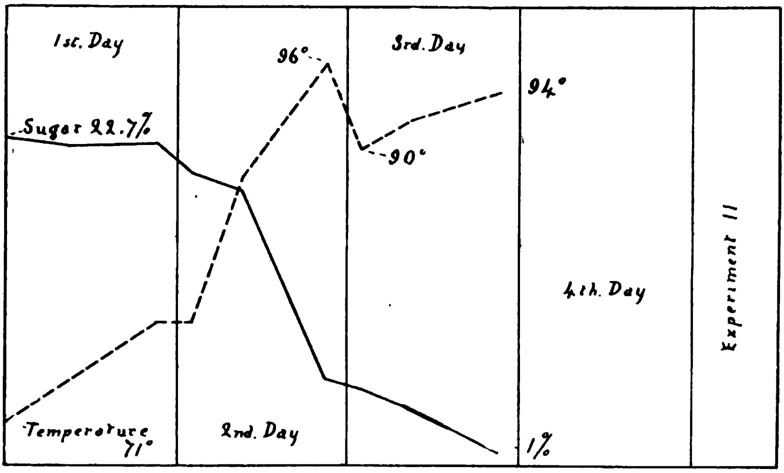

FIG. 8. Sugar and Temperature Changes of Experiment II.

III. *Ripe Grapes; Incomplete Cooling; Sulfite; Pure Yeast.*- On August 25th about twelve tons of Zinfandel grapes in fair condition, except for a considerable amount of black mold, were crushed, stemmed, and pumped into a fermenting vat. The must showed 23.7% Balling and .66% of acid. Pure Champagne yeast was added as the grapes came into the vat. The record of fermentation is as follows:

		Sugar.	Temperature.
Aug. 25,	6:00 P. M.	23.7% B.	74° F.
Aug. 26,	7:00 A. M.	23.2	82
	12:00 M., fermenting well	20.0	85
	6:00 P. M.	16.0	90
Aug. 27,	6:00 A. M.	7.2	96
	12:00 M., cooled to 90° F. and added two pounds sulfite	6.0	98
	6:00 P. M.	6.0	90
Aug. 28,	6:00 A. M., evidently "stuck"	6.0	88
	12:00 M.	5.5	89
	6:00 P. M.	5.0	90
Aug. 29,	6:00 A. M.	5.0	92
	12:00 M.	5.0	92
	6:00 P. M.	4.5	90
Aug. 30,		4.0	92
Aug. 31,	Racked into storage vat	3.0	90

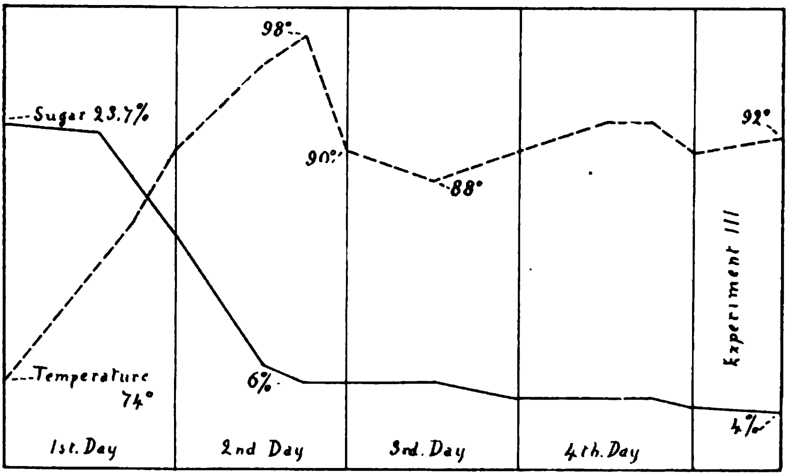

FIG. 9. Sugar and Temperature Changes of Experiment III.

On September 1st the color was 5VR, 18.7, and the wine remained sweet until September 11th, when it was pumped over for an hour. On September 22d it was nearly dry, but still cloudy.

This experiment shows the danger of allowing the fermentation to rise as high as 98° F., but also the possibility of getting it through completely within a few weeks without any serious damage to the quality. In this case the chief loss was the extra trouble and time needed to get the wine dry. The cooling ought to have been done very early on the morning of August 27th instead of waiting until the afternoon. It was a mistake also to add the sulfite at noon on August 27th. The sulfite, if used at all, should have been added on the evening of August 26th, before the high temperature was reached.

The curves of Fig. 9 are instructive in several particulars. Compared with those of Fig. 10 they show plainly that the hottest fermentation is not necessarily that which finishes first. In Fig. 9 the sugar curve drops very rapidly from the middle of the first day to the middle of the second, when it comes to an abrupt stop, becoming almost horizontal for twenty-four hours. The rapid loss of sugar is accompanied by a corresponding rapid rise in temperature due to the former. The temperature of 98° reached practically stops the fermentation completely for twenty-four hours. This is shown both by the sugar remaining unchanged and by the temperature falling. The wine was cooled from 98° to 90° by the machine, and then instead of rising again, as it would have done if there had been any active fermentation going on and as it did after every cooling in Experiments I and IX (see Figs. 5, 7, and 10), it fell to 88°. This shows that there was not enough fermentation going on to counterbalance the heat lost by radiation. The vat had "stuck." The "sticking," however, was not so serious as it often is in vats which rise higher than 98°, or stay at this temperature for some time. The cooling as soon as the temperature reached 98°, and the aëration practiced afterwards, revived the fermentation, as is shown by the gradual rise of the temperature curve and the fall of the sugar curve.

IV. *Over-ripe Grapes; Dilution; Addition of Acid.*—On September 1st at 11 A. M., five tons of Zinfandel grapes were crushed and stemmed into a fermenting vat. The grapes were over-ripe, some of the berries dried, and there was a large amount of black mold. The must showed 29.5% Balling and .7% acidity. It was diluted with 250 gallons of water, to which was added 6 pounds of tartaric acid.

The temperature of the grapes at the start was 73° F., and within thirty-six hours had risen to 90° F. at the bottom of the vat and 104° F. in the cap. The fermentation stuck when the sugar had fallen to 7% Balling, and could not be revived by cooling. The wine was used for port, as an attempt to make it dry would probably have resulted in spoiling it completely.

This experiment shows the futility of attempting to make a dry wine in a hot climate from over-ripe grapes, even if the acidity is increased artificially and the sugar decreased by dilution, unless we adopt some means of controlling the temperature.

V. *Over-ripe Grapes; Dilution; Addition of Acid; Control of Temperature by Use of Sulfites.*—A vat of Zinfandel grapes, similar in every respect to those used in Experiment IV, was diluted and acidified in exactly the same way and an attempt made to control the temperature by the occasional addition of a calculated amount of a solution of potassium meta-bisulfite. The experiment was a failure, as the temperature ran up to a higher point than that reached in Experiment IV, and the wine stuck with 12% Balling.

This was by no means a conclusive test of the method, as the amount of sulfite used was too small. The use of sulfite was tested again in Experiment VII.

VII. *Ripe Grapes; Pure Yeast; Control of Temperature by Use of Sulfites; Pomace and Must Fermented Separately.*—(Debono method, see Bulletin No. 167, p. 18.) The grapes used in this experiment consisted of 29% Charbono, 29% Lenoir, and 42% Burger; nine tons in all. They were ripe and in good condition, the mixture showing 22.5% Balling. The following is the record of the fermentation:

September 2d, 3:00 P. M. Crushed and added potassium meta-bisulfite solution (=.06 per mil.) and 15 gallons of Champagne yeast accustomed to sulfite.

September 3d, 7:00 A. M. The fermentation had commenced, and the must was drawn off into an open vat and given another dose of sulfite solution twice as large as the first dose (=.12 per mil.). The must and pomace were then allowed to ferment separately.

The further progress of the fermentation is shown by the following table:

	Must.		Pomace.	
	Temp.	Sugar.	Temp.	Sugar.
Sept. 3, 6:00 P. M.	74° F.	22.5% B.	74° F.	22.5% B.
Sept. 4, 7:00 A. M.	86	13	94	6
5:00 P. M.	94	10	98	2.5
Added more sulfite (=.12 per mil.).				
Sept. 5, 7:00 A. M.	96	4.5	100	1.5
12:00 M.	98	2.5	100	1.0

3:00 P. M. The must, which had fallen to 2% Balling, was now pumped back on to the pomace and allowed to stand, after a thorough stirring, for twenty-four hours. When first mixed, the vat showed a temperature of 98° F. and 2% Balling.
Sept. 6, 7:00 A. M. Temperature 92° F., sugar 1.5% Balling.
12:00 M. Racked off pomace into open vat and aërated. The color of the wine was 2VR, 20.3.
Sept. 7. The wine was transferred to a storage cask.
Sept. 11. The wine still tastes a little sweet and was pumped over for one hour.
Sept. 22. Still shows a slight trace of sweetness.

While this wine did not stick entirely and finally went through perfectly dry, there is no evidence in the experiment that the addition of the sulfite had the slightest effect in preventing high temperatures. The grapes had only 22.5% of sugar and were cool (74° F.) when crushed. If we reckon that each per cent of sugar in fermenting heats the must 1.17° F.,* the temperature of the fermenting grapes should have reached 97.5° F. when 20% of sugar had fermented out. This corresponds almost exactly to what occurred, so that there is no delay of fermentation or moderation of temperature that can be accredited to the sulfite. If sulfites are to be effective for this purpose they must evidently be used in larger doses than those adopted in this experiment.

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*See Bulletin No. 174, pp. 17, 18, 19.

IX. *Ripe Grapes; Pure Yeast; Extraction by Heat; Temperature Controlled by Cooling Machine.*—The grapes used in this experiment were a mixture of Grenache 45%, Zinfandel 31½%, and Lenoir 23½%. They were mature and in good condition except for a few dried and moldy grapes and some green bunches of second crop in the Zinfandel. The must was passed through the heater and back on to the pomace until the temperature of the whole was 125° F., and the whole well stirred. This was on the afternoon of September 8th, and at 9 A. M. of September 9th the must was drawn off the pomace and cooled. The color of the must was 1 VR, 53.4. Yeast was added, and the fermentation proceeded as follows:

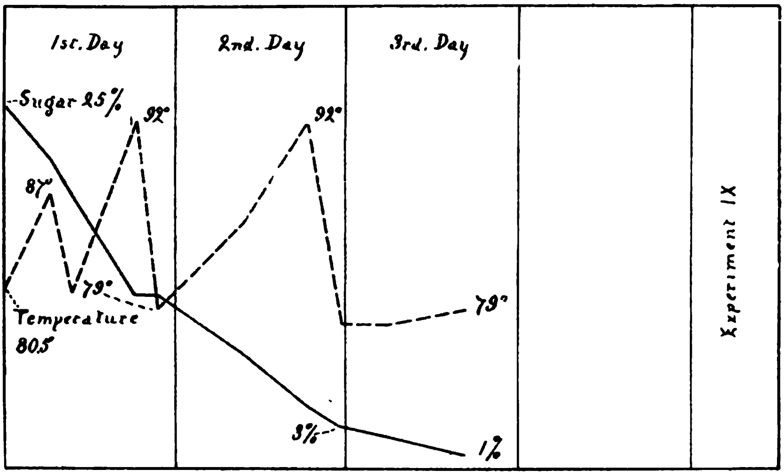


FIG. 10. Sugar and Temperature Changes of Experiment IX.

		Sugar.	Temperature.
Sept. 9,	4:00 P. M.	23.0% B.	84° F.
	7:00 P. M., cooled to 80°	21.5	87
	10:00 P. M.	19.0	80
Sept. 10,	7:00 A. M., cooled to 79°	12.5	92
	10:00 A. M.	12.0	79
	10:00 P. M.	8.0	85
Sept. 11,	7:00 A. M., cooled to 78°	4.5	92
	12:00 M.	3.0	78
	6:00 P. M.	2.5	78
Sept. 12,	7:00 A. M., transferred to a storage cask	1.0	79
Sept. 19,	Still a little sweet and still fermenting.		
Sept. 23,	Pumped over for one hour.		

This experiment exemplifies the benefit to be derived from complete control of the temperature by efficient cooling. The wine required a month to become quite dry, but at the end of that time all the sugar was eliminated, although the wine contained 15.1% of alcohol. It became dry as soon as did the wine of Experiment III, which contained only 12.5% of alcohol but was allowed to reach a temperature of 98° F. The wine was cooled three times, a total of 27° F. being taken out by the cooler. The same result could have been obtained with considerably less cooling if in order to avoid night work the first cooling had not been done sooner than was necessary. The last cooling, moreover, was much greater than was necessary and might have been dispensed with altogether.

The sugar curve in Fig. 10 is in marked contrast with that of Fig. 9. The drop in the curve is just as rapid during the first thirty-six hours, but instead of being checked there it continues for forty-eight hours until the sugar reaches 3%. Here the fermentation is checked slightly but not "stuck," and the wine was practically dry in three days when Experiment III still had 5% of sugar. This difference is undoubtedly due altogether to the fact that Experiment IX was not allowed to rise above 92° F.

EXPERIMENTS: WHITE WINE.

VI. *Defecation by Sulfuring; Pure Yeast; Fermentation in Puncheons.*—The grapes used in this experiment were about eight tons of Johannisberg and Franken Riesling. They were in excellent condition and were a striking example of what can be done by proper care and cultivation, even with varieties presumably so unsuited to a hot climate as the grapes of the Rhine. The grapes were thoroughly and evenly matured and showed no sunburn, mildew, or mold.

They were crushed into an open vat, and the first 500 gallons of must which ran off was pumped into a heavily sulfured cask. After settling for twenty-four hours, the must was drawn off into three sulfured puncheons and started with pure Champagne yeast.

The following is the record of the fermentation:

Date.	Sugar.	Temperature.
August 26th	22.5% B.	78° F.
August 27th	16.7	85
August 28th	9.1	88
August 29th	4.7	88
August 30th	2.8	88
August 31st	2.0	87

The wine fermented slowly, and on September 2d was still a little sweet. It was then pumped-over to aërate it, and on September 8th was dry and nearly clear.

VI*a*. *Fermentation Started on Skins; Pure Yeast; Fermentation in Puncheons.*—After drawing 500 gallons of must off the crushed grapes of Experiment VI, the remainder was left on the skins for twelve hours. At the end of this time a slight fermentation was perceptible, and the must was drawn off into sulfured puncheons and started with Champagne yeast. The following is the record of the fermentation:

Date.	Sugar.	Temperature.
August 26th	25.0% B.	78° F.
August 27th	8.7	92
August 28th	5.9	89
August 29th	4.4	87
August 30th	4.0	86
August 31st	4.0	84

The wine was treated in the same way as in Experiment VI, but on September 8th it was still cloudy and slightly sweet. On September 22d it was cloudy and fermenting and had a slight brownish color. It finally became nearly dry about October 21st, and the brownish tint had almost disappeared, though it was still cloudy.

A 50-gallon cask of each experiment wine was shipped to Berkeley and stored in the Station cellar. They were tasted on November 24, 1905, with the following results:

Exp. I. Perfectly clear, full flavor, sound, fruity, and agreeable, but with a slight taste of dried grapes.

Exp. II. Cloudy, of poor color and a little mousey.

Exp. III. Clear and a good wine, but inferior to Experiment I.

Exp. VII. Clear, odor peculiar, flavor good.

Exp. IX. Clear, a little better than Experiment VII.

Exp. VI and VI*a*. Nearly clear, contain a small amount of sugar. Good, full-bodied wines of somewhat Sauterne type.

Exp. VIII. Tastes flat, but otherwise a fair wine of neutral Sauterne type.

Order of merit of the red wines: I, III, IX, VII, II; of the white: VI, VI*a*, VIII.

The analyses of the wines made on December 1, 1905, by Prof. George E. Colby, are given in the following table:

TABLE II.

Analyses of Experiment Wines from Fresno.

December 1, 1905.	Exp. I.	Exp. II.	Exp. III.	Exp. VI	Exp. VI*a*.	Exp. VII.	Exp. IX.	Exp. VIII.
Specific gravity	.9935	.9955	.9970	.9900	.9925	.9980	.9930	.9910
Alcohol, per cent by volatile	13.80	12.30	12.50	13.25	14.50	11.70	15.10	12.60
Alcohol, grams per 100 cc	10.95	9.76	9.92	10.51	11.51	9.29	11.98	10.00
"Extract," grams per 100 cc	3.02	3.10	3.25	2.19	2.80	3.30	2.60	2.07
Ash, grams per 100 cc	.37	.38	.45	.25	.37	.57	.41	.33
Acidity, total, as tartaric; grams per 100 cc	.457	.397	.442	.390	.337	.375	.315	.375
Acidity, fixed, as tartaric; grams per 100 cc	.324	.285	.300	.300	.292	.300	.232	.315
Acidity, volatile, as acetic; grams per 100 cc	.108	.090	.114	.072	.036	.060	.066	.048
Sugar, total, grams per 100 cc	....	.200	.300	....	.300	.300	....	....
Tannin	.292	.160	.240	....	....	.280	.260	....

A puncheon of each of the experiment wines was kept separate and left at the cellar where they were made. They were tasted on January 1, 1906. The wines made by the new method, I and IX, were bright, dry, clean-tasting, and of good flavor. The wines made in the ordinary way, III and VII, were dry and clean-tasting, clear but not bright. The main differences to be perceived in the wines were that those made by the new method were brighter and more astringent than the others.

The white wines were all in excellent condition, and, on the whole, surprisingly good wines for the district and the conditions in which they were made. The Burger was rather flat and lacking in acid.

COLOR-CHANGES IN THE RED WINES.

The record of the color-changes in the various red wines is shown in the following table. The same record is shown graphically in Fig. 11.

TABLE III.

Color of Experiment Wines.

	Exp. I.	Exp. II.	Exp. III.	Exp. VII.	Exp. IX.
Before fermentation	2VR, 65.6				1VR, 53.4
After fermentation	3VR, 27.5	R, 13.1	5VR, 18.7	2VR, 20.3	22.4
3 months' fermentation		3R+Y, 7.5	5VR, 13.4	2R, 13.0	4VR, 19.6
4½ months' fermentation	3VR, 16.2	3R+Y, 5.3	R, 10.2	1R, 9.7	4VR, 17.0
Loss of color in 3 months		43%	28%	36%	12%
Loss of color in 4½ months	41%	60%	45%	52%	24%

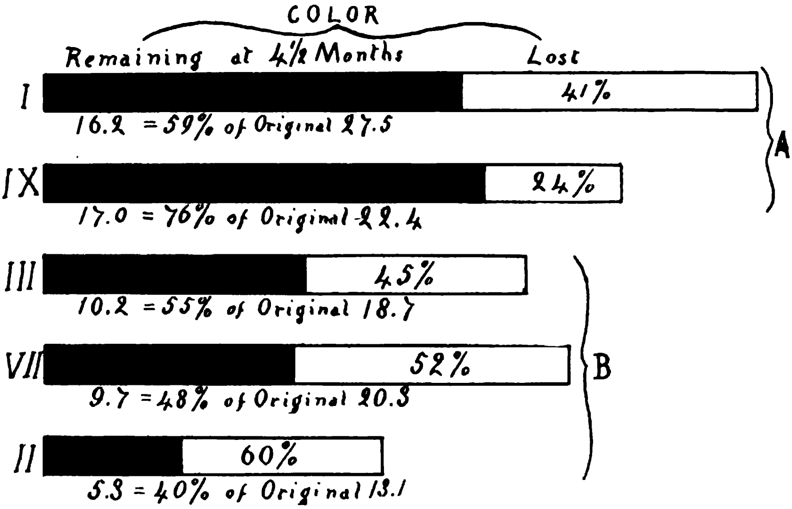


FIG. 11. COLOR OF THE RED EXPERIMENT WINES.

A. Color extracted by heating before fermentation.
B. Color extracted in the ordinary way by fermentation.
Shaded Portion = Color remaining January 15, 1906.
Clear Portion = The amount of the original color lost.
The sum of the above is the amount of color in the wine when it was taken from the fermenting vats to the storage casks.

Figure 11 shows graphically two very important points in favor of the new method: First, the color extracted by heating before fermentation is as high or higher than that obtained by the usual method; and second, that it is more stable. Leaving out the wine of Experiment II, which was made from unripe grapes and was therefore abnormal, we find that the average loss of color of the heated wines in 4½ months was 32.5%, while that of the ordinary wines in the same period was 48.5%. Experiment II was cloudy and of poor quality.

CONCLUSIONS.

The most important conclusion to be drawn from these experiments is that sound dry wine of fair quality can be produced in the upper San Joaquin Valley and similar regions from the varieties of grapes growing there, simply by ordinary attention to cleanliness, the sterilization of cooperage, and more than ordinary attention to the control of temperature.

For white wines a thorough preliminary defecation of the must by means of sulfur fumes and the use of pure yeast or yeast starters is advisable.

For red wines some form of cooling machine is essential, and the temperature of the fermenting wine should never exceed 95° F., and if possible should be kept below 92° F. This can be easily and perfectly done by means of the cooling machine described in Bulletin No. 174.

The grapes both for white and red wines should be thoroughly ripe. Ripeness must be determined by the flavor and appearance of the grapes more than by the amount of sugar they contain. We can not hope to get the best results from imperfectly ripe grapes even if they contain 22% of sugar. Some varieties in the climate of the San Joaquin Valley are not perfectly mature for wine-making purposes until they contain 25% of sugar or more. Better results are to be obtained by diluting and, if necessary, adding tartaric or citric acid to over-ripe grapes in this region than by attempting to make wine from under-ripe grapes which have not developed the color, body, and flavor necessary for the production of good wine.

Finally, the claims made in Bulletin No. 167 for the new method of wine-making have been abundantly verified by these experiments. The preliminary extraction of color, tannin, and body by means of heating before fermentation has utilized more perfectly than any other method tested, all the good qualities of the grapes and remedied more completely the bad qualities. The wines made by this method have shown better color and flavor, have developed and kept better, and have in every way shown themselves superior to the others. The only thing remaining to be tested regarding it is the cost when carried out on a large scale. For this purpose a plan of a cellar suitable for the use of this method, and the mode of operation with this plan, are given. While the method could be adapted to any cellar without changing the vats or casks at present in use, it would be much simpler and more easily managed in a cellar specially constructed for the purpose.

The plan as given provides only for the manufacture of dry red wine. The addition of some defecating vats would make it equally adapted to the making of dry white wine. The manufacture of sweet wines would be better done in a separate crushing and fermenting room adjoining, though it could be done with the same machinery. It is at present doubtful if the heating method could be adapted to the manufacture of port wine. The experiments at present indicate that too much tannin would be extracted for the best port. It might be possible to modify the method so as to make it applicable to this purpose, but at present this seems hardly necessary, and the improvements in the manufacture of port will probably lie in the direction of cool fermentations and long maceration of the pomace.

PLAN OF FERMENTING ROOM TO WORK 50 TONS OF RED GRAPES PER DAY.

EXPLANATION OF FIGURES 12 AND 13.

Fifty tons per day = 11,000 gallons of crushed and stemmed grapes.

Fifty tons per day = 8,300 gallons of wine = 250,000 gallons per season of thirty days.

(By working continuously 400,000 gallons per season could be handled with the same installation.)

H. Four extracting vats, 12 feet by 12 feet by 12 feet; capacity, 13,000 gallons. (11,000 gallons will fill them to within 19 inches of the top.)
D. Two drainage vats, 12 feet by 12 feet by 6 feet; capacity, 6,500 gallons.
F. Six fermenting vats, 20 feet by 10 feet by 6 feet 6 inches; capacity, 9,000 gallons. (8,500 gallons will fill them to within 10 inches of the top.)
W. Two pump wells to hold 250 gallons.
E. Gomot heater to heat 1,000 gallons of must from 70° to 150° F. in one hour.
C. Cooler consisting of 240 feet of 1½-inch copper pipe and 3-inch No. 10 canvas hose. (Will cool 1,000 gallons of must from 125° to 80° F. in one hour with 1,000 gallons of water at 70° F.)
P. Two pumps to handle 1,500 gallons per hour each.
K. Two cooling coils consisting of 80 feet of 1-inch copper tubing (Maximum cooling effect needed, allowing 50% for cooling by radiation (See Bulletin No. 174, p. 18), requires 125 gallons of water at 70° F. per hour for 72 hours for each vat. This equals 9,000 gallons for each vat or each day. This will keep the wine below 92° F.)
T. Carrier for crushed grapes.
S. Carrier and strainer for crushed grapes.
L. Strainer at bottom of heating vat.
R. Crushing platform.
M. Must sump to receive must from strainer S.
Y. Carrier for extracted pomace.
b. Pipe leading from heater to heating vats.
a. Pipe leading from well of strainer to drainage vats.
o. Manholes for removal of extracted pomace.
e. Pipe for conducting heated must to pump well.
r. Pipe for conducting cold must into drainage vats.

Method of Operation.—1. The grapes are crushed and stemmed in the ordinary manner on the crushing platform (R). A solution of potassium meta-bisulfite is gradually added to the crushed grapes as they pass from the crusher. The solution is made by dissolving 80

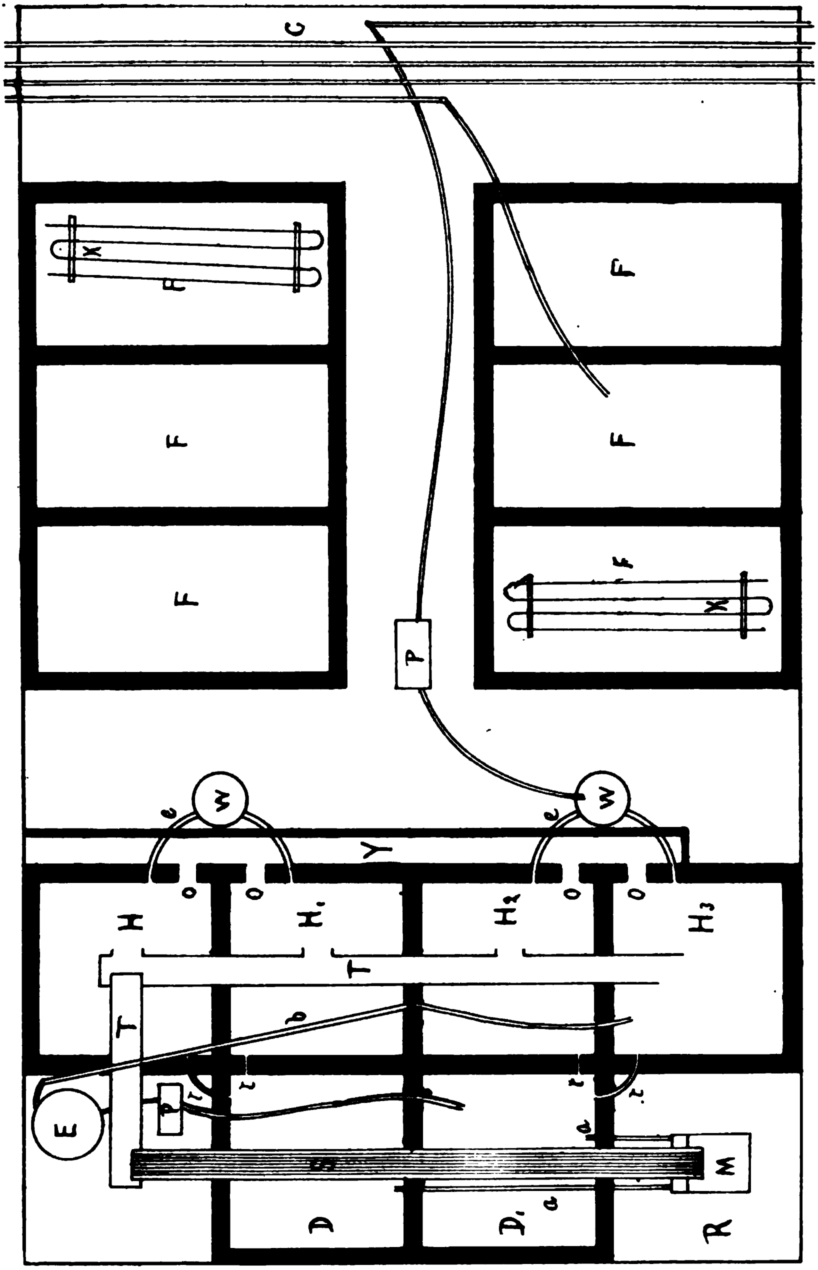


FIG. 12. GROUND PLAN OF CRUSHING, EXTRACTION, AND FERMENTING ROOM.

pounds of the salt in 100 gallons of water, and is used at the rate of one gallon to every ton of crushed grapes. This is equivalent to .2 per mil. of SO_2, and is sufficient to prevent fermentation until the extraction can be accomplished, and helps to dissolve the color of the skins, and to prevent the must from becoming oxidized.

2. The crushed grapes are carried by an ordinary drag-carrier up the strainer (S) and along the flume (T) to the extraction vat which is being used. The strainer (S) is similar to the usual box flume used in wineries, except that it is provided with a false bottom consisting of longitudinal slats, which permit a large portion of the must to run back into the must sump (M).

3. The must is then allowed to run from M and from the extraction vat into one of the drainage vats (D).

4. As soon as the drainage vat is nearly full, or any time within twelve hours, the must is passed through the Gomot heater (E) and pumped back on to the top of the grape skins in the extraction vat. The opening (*r*) at the bottom of the extraction vat is meanwhile left open so that the hot must entering at the top will drive out the cold must at the bottom into the drainage vat.

5. As soon as the must, flowing from the extraction vat into the drainage vat, shows a rise in temperature the heater is connected with the opening (*r*) at the bottom of the extraction vat. The stream of hot must now enters the extraction vat from the bottom below the strainer (L), and being hotter and therefore lighter than the rest of the must in the vat will tend to rise and thus to equalize the temperature in all parts of the vat of crushed grapes. In this way the skins will all be thoroughly heated, and the extraction completed without stirring or using the heater on half-heated must, which would result in a loss of efficiency.

The temperature to which it will be necessary to raise the must as it passes through the heater will depend on the initial temperature of the grapes and on the amount of must which it is possible to separate. By proceeding in the way described, it would undoubtedly be possible to separate an amount of must equal to two-thirds the volume of the grapes, or about 145 gallons per ton. If the temperature of the grapes therefore was 70° F., and the must was passed through the heater at a temperature of 153° F., the whole contents of the extracting vat would be raised to 125° F., which is the temperature required.

6. If necessary to hasten or complete extraction, the must should be allowed to run into the pump well (W) and returned to the top of the pomace in the extracting vat.

7. It is then allowed to stand for sufficient time to extract the necessary color and tannin. This time will differ according to the kind of grape, the kind of wine desired, and the temperature of extraction. If the temperature of 125° F. is used the time of extraction will be from

four to eight hours. With higher temperatures it will be less, with lower more. Lower temperatures and long maceration will give more tannin; higher temperatures with shorter maceration will give less tannin for a given amount of color. This is due probably to the extraction of tannin from the seeds which takes place after long contact with the hot must.

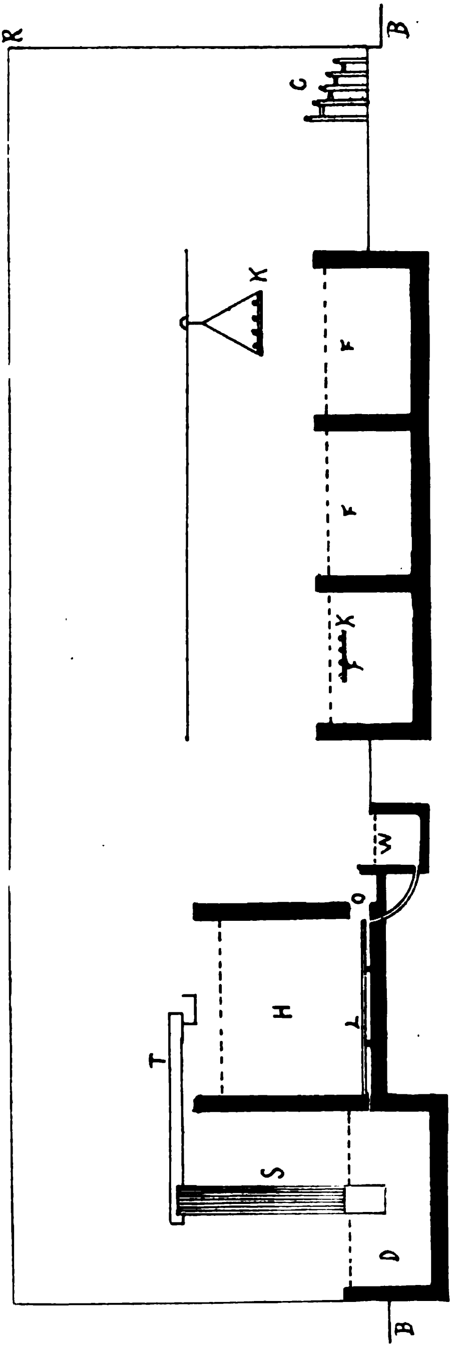


FIG. 13. VERTICAL SECTION OF PLAN SHOWN IN FIG. 12. (See p. 31.)
B. Ground level. R. Roof. H. Extraction vat. D. Drainage vat. F. Fermentation vat.

8. As soon as the extraction is complete, the hot must, containing color and tannin, is allowed to run into the pump well (W) and pumped through the cooler (C) into a fermenting vat (F). The temperature of the must when it reaches the fermenting vat should be about 80° F. The must as it passes from the cooler (C) into the fermenting vat should be allowed to fall through the air in order to aërate it thoroughly. This is essential for a quick and thorough fermentation.

9. As the fermenting vat is being filled, about 75 gallons of yeast should be added. This yeast may be prepared as described on page 13, or it may be simply some fermenting wine taken from one of the other vats that is in full fermentation. The use of pure yeast as described is preferable, as the actual amount of yeast added is more easily controlled. If we use 75 gallons of fermenting wine from another vat the amount of yeast in it, and still more the character of it, will vary very

much according to the stage of fermentation at which the wine has arrived. Yeast prepared by the method indicated will always be in full vigor and the number of active cells present will be fairly constant. This will cause the fermentations to be more regular and simplify the control of temperature.

10. As soon as the must ceases to run from the extraction vat the gate (O) is opened and the pomace shoveled out to the carrier (Y), which takes it to a continuous press. The must from the press is mixed with that already in the vat. It will probably be unnecessary to cool the press must.

11. Fermentation will start immediately, and as soon as the temperature rises to 90° F. one of the cooling coils (K) should be lowered into the must a couple of inches below the surface and water run through it. No stirring of the fermenting liquid will be necessary, as the heating must rises to the surface, is cooled on contact with the copper coil, and sinks again. This keeps up a constant circulation. A moderate aëration should be given once a day, either by pumping-over or by means of an air compressor. Unless this is done the fermentation will be inconveniently slow. If too much aëration is given the quality and color of the wine will be injured.

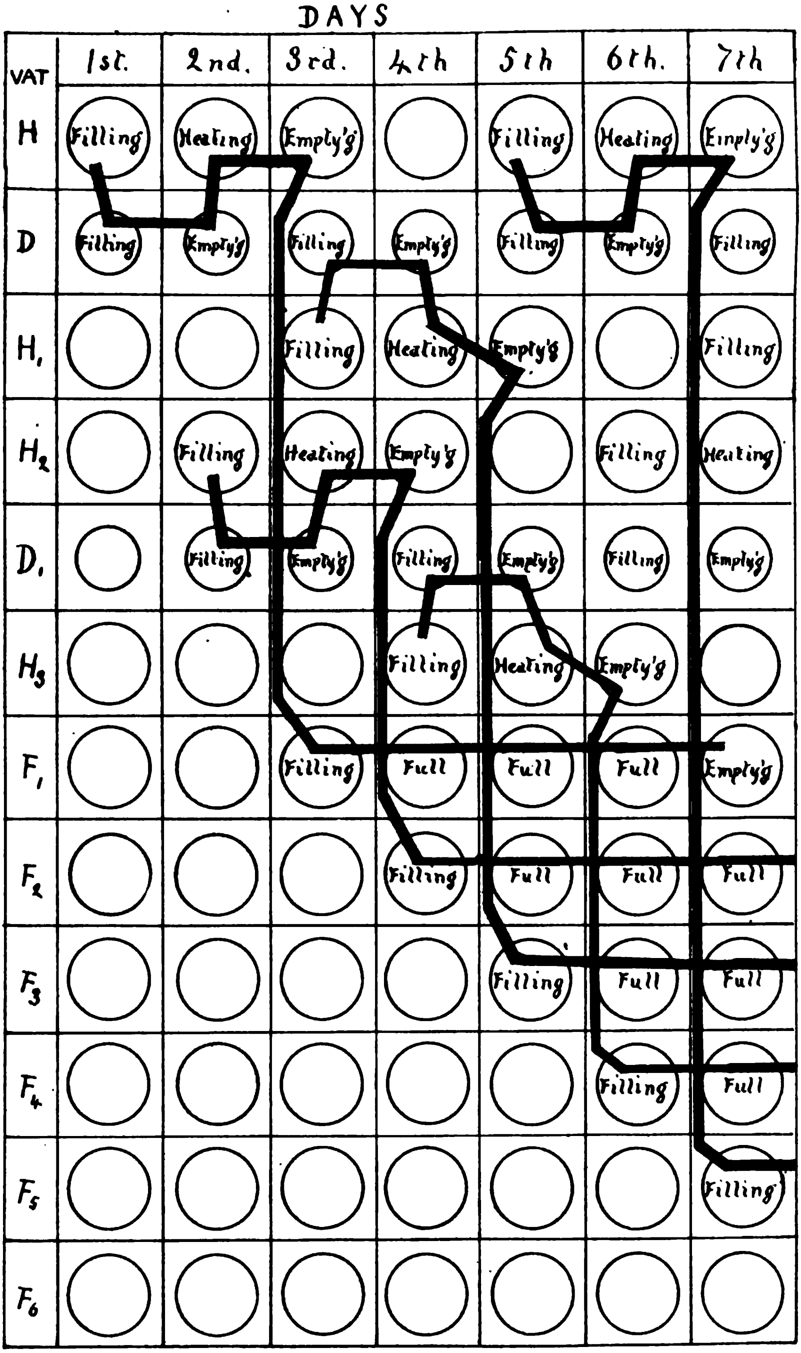
12. At the end of three days the wine should not contain more than 1% or 2% of sugar and should mark 0 on the saccharometer. It should then be transferred to the storage cellar, being given a thorough aëration in the transfer.

Figure 14 shows the sequence in which the various vats shown in Figs. 12 and 13 would have to be used. Each circle represents a vat.

Each column represents a day, and shows the condition of all the vats on the day indicated at the head of the column.

Each horizontal file shows the condition of a vat on the various days indicated.

Each heavy line represents the course of the must handled on a single day. For example, on the first day the must from the crusher falls into extraction vat H and runs into drainage vat D. On the second day it is taken from D, passed through the heater and back into H. On the third day the must, now containing color and tannin, is taken from H and passed through the cooler into fermenting vat F. It stays in F during the fourth, fifth, and sixth days, and is transferred to a storage cask on the seventh. When everything is in full running, as on the seventh day, and as indicated in the figure, one of the extraction vats (H_1) is being filled from the crusher. The cold must from H_1 is draining into one of the drainage vats (D). Another extraction vat (H_2) is being heated by the must from the other drainage vat (D_1). Another extraction vat (H) is being drawn off and the hot red must



VAT	1st.	2nd.	3rd.	4th	5th	6th.	7th
H	Filling	Heating	Empty'g		Filling	Heating	Empty'g
D	Filling	Empty'g	Filling	Empty'g	Filling	Empty'g	Filling
H_1			Filling	Heating	Empty'g		Filling
H_2		Filling	Heating	Empty'g		Filling	Heating
D_1		Filling	Empty'g	Filling	Empty'g	Filling	Empty'g
H_3				Filling	Heating	Empty'g	
F_1			Filling	Full	Full	Full	Empty'g
F_2				Filling	Full	Full	Full
F_3					Filling	Full	Full
F_4						Filling	Full
F_5							Filling
F_6							

FIG. 14. Diagram showing order in which vats must be used.

passed through the cooler into one of the fermenting vats (F_5). The fourth extraction vat (H_8) is empty and being prepared for filling on the following day. Three of the fermenting vats (F_2, F_8 and F_4) are full of fermenting wine, and one (F_1) is being emptied of fermented wine. The sixth fermenting vat (F_6) is empty and ready for filling the following day.

The whole process could be very much shortened if needed. The extraction, instead of taking seventy-two hours as indicated, could be better done in thirty-six hours, and the must need not stay in the fermenting vats, from the commencement of filling to the end of emptying, more than four days. In this way the output could be increased from 8,300 gallons per day of twenty-four hours to over 13,000 gallons; and with the addition of another fermenting vat and a corresponding increase of the cooling apparatus to 15,000 gallons per day.

ACKNOWLEDGMENTS.

The successful carrying out of the foregoing experiments was rendered possible by the coöperation of members and employés of the California Wine Association, who provided all the necessary grapes and cellar facilities and assisted materially by their interest and coöperation.

Our thanks are also especially due to Messrs. T. R. Meakin and son, whose advice and skill in constructing the needful apparatus very much facilitated every stage of the work; and to Mr. B. J. Wingfield, who carefully and skillfully attended to all the details of the experiments.

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AGRICULTURAL EXPERIMENT STATION
E. J. WICKSON, ACTING DIRECTOR

CIRCULAR No. 22

(AUGUST, 1906.)

DEFECATION OF MUST FOR WHITE WINE.

BY
FREDERIC T. BIOLETTI.

The manufacture of wine consists in a series of operations which has for its objects: First, certain chemical changes, the chief of which is the production of alcohol from the sugar, and, second, certain physical changes, the chief of which is the clarification of the wine.

The clarification of the wine is accomplished by separating it from all solid or undissolved particles. Some of these particles consist of fragments of skin, pulp and seeds, dust, yeast and germs of various kinds, introduced with the grapes. Others are due to physical and chemical changes which take place during the manufacture, by which substances dissolved in the must or young wine become insoluble in the finished product. Such are the albuminoids and cream of tartar which are precipitated by the aging of the wine. Finally, there are the cells of yeasts, molds and bacteria which grow in the wine during and after fermentation.

All these impurities must be separated from the liquid by settling and decantation, or by straining and filtration, and the wine is not marketable until they have all been eliminated.

In the case of red wine a large part of this separation takes place in the fermenting vat. The tannin of the skins and seeds diffuses into the must and coagulates the albuminoids which, together with much other solid matter, are removed from the wine by the filtering action of the pomace. The utility of this early partial clearing of the wine is seen in the superior quality of the "free run," in which the filtering action is considerable, over the "press wine" where it is less.

In the case of white wines the tannin is insufficient to precipitate the albuminoids and the filtering action of the fresh grapes is very slight. For these reasons, the clearing of white wines is always much slower than that of red and the sediment more bulky. Many of the troubles of white wine can be avoided and the quality improved if the must is given a preliminary clearing or "defecation" before fermentation. The wine will clear more rapidly, and will be less liable to secondary fermentations, and will be, in general, sounder and cleaner tasting. It also makes the use of pure yeast more effective.

Some of the impurities can be kept out of the must by careful handling of the grapes or by hand sorting before crushing. These methods, however, are expensive and at best very incomplete. If the grapes are stemmed, a certain quantity of leaves, dried and rotten grapes and particles of soil are thrown out, but the proportion is not large and the absence of the stems increases the difficulty of pressing.

If great care and cleanliness are exercised in gathering, crushing and pressing and the grapes are only handled when cold, the must will free itself of most of its impurities during the first 24 hours by settling. If the must is warm, however, or contains a large amount of yeast taken from boxes, crushers or conveyers, fermentation will start before the impurities have time to settle. During fermentation the continual escape of carbonic acid gas will keep all the solid particles in suspension and any of them which are capable of injuring the quality of the wine will have abundant time to do so. Some means of preventing all fermentation for 24 or 48 hours is necessary if the impurities are to be separated before fermentation.

Such a means we have in the use of sulphurous acid.* Sulphurous acid may be obtained in the liquid state in iron bottles, dissolved in alcohol, or in the form of potash salts (potassium meta-bisulphite), but the cheapest and most convenient source for the purpose of defecating white must is sulphur. If sulphur is burned, it is changed into a gas, which is pure sulphurous acid.

The most convenient way of using the fumes of burning sulphur for clearing the must is to have two or three defecating vats or casks. These vats should be headed up and of such size that one of them is filled in a day. The proper quantity of sulphur is burned in the cask immediately before introducing the must. The amount necessary will vary according to the temperature and the condition of the grapes, but will lie between .1 and .2 per mille. That is, for a puncheon of

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* For a fuller discussion of the use of sulphurous acid in wine-making see Bull. 167, pp. 45-51.

175 gallons 2 to 4 ounces of sulphur will be needed, or for a larger vat about one pound of sulphur for every 1000 gallons.

In order that this amount of sulphur shall be sufficient, some means must be used to make the must absorb most of the fumes. This is most easily done in small cellars by pumping the must through a rose nozzle which projects only a few inches into the cask. For larger cellars where steam pumps are used the must may be forced to fall in a spray by means of a piece of board about 1 foot square suspended in the defecating vat 15 inches below the nozzle through which the must enters. The exact amount of sulphur to use under the conditions of any particular cellar can be determined only by trial. If the must commences to ferment before it clears, more sulphur should be used. If it remains several days without fermenting after yeast has been added, less should be used. If too much is used no harm is done except that time is lost.

The usual way of burning sulphur in a cask is to use sulphur matches or tapes, which are strips of thin cotton cloth which have been dipped several times in melted sulphur. These tapes are hung on an iron wire about 18 inches long, bent up at one end to hold the tape and fastened to a bung at the other. This method has the defect that some of the sulphur melts and drips on to the bottom of the vat, where it is incompletely burned. This incompletely burned sulphur may communicate a bad taste to the wine. The same is true of the burning of the cloth to which the sulphur is attached. A better method is to use thin paper instead of cloth for the tapes and to burn them in a sulphur cage. A sulphur cage is simply a hollow cylinder of iron, or better, of porcelain, open on top and closed below, sufficiently narrow to enter the bung hole and sufficiently long to hold the required amount of sulphur tape. The cylinder is pierced with numerous holes in all parts except the bottom inch, which acts as a cup to catch all the melted sulphur. The cylinder is suspended at 18 inches below the head of the vat by means of a piece of iron wire attached to a bung.

The defecating vat may be filled completely, and the must should be allowed to settle for at least 24 hours and not more than 48. At the end of this time it should have deposited most of its impurities. It is then drawn off into the casks or vats in which it is to ferment.

In drawing off, the defecated must should be thoroughly aerated. This is accomplished by allowing it to fall as a spray into the pump well and in the same manner from the top of the cask into which it is pumped. This aeration rids the must of some of its sulphurous acid and supplies the oxygen necessary for the development of the yeast. The must will ferment without the addition of yeast, for defecation practised as described never completely frees the must from all yeast cells. It may, however, be a long time in starting and it is better to use a starter.

This starter may be simply some must from a cask which is already in full fermentation. Full fermentation may be considered to be when from one-third to one-half of the sugar has disappeared. For example, must which contains originally 24% Balling may be considered in full fermentation when the saccharometer shows between 16% and 12% B. Ten gallons of such a starter is sufficient for 1000 gallons of defecated must.

Care, of course, should be taken to use starters only from the casks or vats which have been filled with the best grapes. The most satisfactory starter is that prepared from pure yeast in the manner described in Circular No. 23.

Summary.

The defecation of must with sulphur fumes for the production of white wine is desirable because:

1. It eliminates the worst of the impurities before they have contaminated the wine.
2. It diminishes the amount of sediment in the casks at the first racking.
3. It causes the wine to clear much more rapidly after fermentation.
4. It eliminates much of the albuminoid substances which are the preferred food of injurious bacteria.
5. It clears the wine of most of the molds, wild yeasts and bacteria.
6. It enables us to use pure yeast with the greatest effect.

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CIRCULAR No. 23

(AUGUST, 1906.)

PURE YEAST IN WINERIES.

BY

FREDERIC T. BIOLETTI.

While in the present state of the wine-making industry and of the general lack of knowledge among wine makers of the principles of fermentation, the use of pure yeast is not to be universally advocated, there are many cases in California where it can be of great utility.

Both laboratory and cellar experiments on a sufficiently large scale, and continued for a sufficiently long time, have fully demonstrated that most excellent results can be obtained by the use of pure yeast. This is especially true as regards white wine.

The principal benefits to be obtained at present are a thorough fermentation, a rapid clearing and an absence of the disagreeable flavors of secondary fermentation, which are only too common in many of our Californian wines. These benefits are to be obtained, however, in cellars only where especial care in the ordinary processes of wine-making are at present practised. In many of the larger wholesale wineries, or in those where ordinary carefulness is not exercised, little benefit would result from the use of pure yeast. There are other much more important reforms to be introduced first. The great improvements in methods which have been introduced in late years in certain large wineries, however, make it probable that before long many of them will be in a position to make use of the advantages of pure yeast.

For this reason it is advisable that the methods of handling pure yeast practically in wine-making should be made familiar to the wine-makers of small cellars where it is at present feasible. This circular is issued, therefore, with the hope of interesting some of the more progressive wine-makers in this method of improving their product.

It should be clearly understood at the beginning that the purity of the yeast is of less importance than its character. The yeast must be of the *right kind.* Beer yeast will give a flavor of beer, and will, moreover, fail to transform all the sugar, leaving a half fermented liquid that will inevitably spoil. Bread yeast, apiculate yeast, any of the innumerable species of yeast that occur in fermenting liquids, will simply injure the wine. Even the true wine yeast has many varieties, each with its own qualities, and it is unsafe to use any pure yeast until it has been properly tested for the purpose contemplated. The yeast must be obtained, therefore, from a perfectly reliable source, where it has been proved suitable for the conditions in which it is to be used. An unsuitable or untested yeast is as sure to give unsatisfactory results in the fermenting vat as a lot of seedlings in the peach orchard.

On the other hand, the *best* results are to be obtained only if our original stock is perfectly pure. If the stock is contaminated with vinegar germs, wine-flowers, or molds, it may do more harm than good. The effect would be similar to that obtained by planting wheat seed mixed with cheat or alfalfa seed with dodder.

For these reasons the Experiment Station has selected and tested a number of yeasts which have been under observation for several years, and is ready to recommend one for use in practice which has uniformly given good results. We are prepared to supply small quantities of this yeast in an absolutely pure state to a limited number of wine-makers for use during the present season.

If the directions of this circular are carefully followed, good results will be obtained, provided nothing is done to counteract them. Pure yeast, however, will not overcome altogether the effects of infected vats and casks, nor will it enable the wine-maker to produce Château Lafite from raisins, and above all, it will not aid him in the vital point of cool fermentation. If, however, the usual precautions known to all good wine-makers are taken, pure yeast will give satisfactory results.

The principal things to be kept in mind are to get the grapes or must into the vats as clean as possible, to introduce the starter before any spontaneous fermentation has started, and to control the temperature.

For red wine some such cooling device as that described in Bulletin 174 should be used, unless very small vats are employed and the fermentation is to take place in the cooler sections of the State. Pure yeast is particularly valuable when used in connection with the method of making red wine described in Bulletin 177. For white wine good results will be obtained in almost all cases, though a preliminary defecation is desirable. This defecation may be obtained by the use of sulphur fumes or of meta-bisulphite as described in Circular No. 22.

The small quantity of pure yeast received must be increased by the wine-maker until it is sufficient for a "*starter.*" A starter is a quantity of must containing young, vigorous yeast in sufficient amount to take possession of the vat of grapes or cask of must before the germs naturally existing there have time to develop. The method of making this starter is described later.

This starter must be *relatively pure.* It is always used when in full fermentation, that is, when it contains the maximum number of pure yeast cells and before the weakening of the yeast has allowed any bacterial or other spores that may be present to develop or increase. The few foreign germs, therefore, which may get into the starter during the last manipulations may be disregarded, as they are in such an infinitesimal minority that they have no chance to develop sufficiently to do any harm before the wine is finished and safe from their attack. With ordinary care in the manipulation of the starter they will be incomparably less numerous than the same germs existing naturally in the crushed grapes to which the starter is added.

The *amount* of yeast added must be sufficient. As a rule the amount of starter should be about 1% of the volume of the grapes or must to be fermented.

If the grapes have been partially sterilized by heat or the must by defecation, less will be sufficient. If they contain considerable amounts of natural germs, more will be needed. If the infection with molds, yeasts and bacteria due to bad grapes, unclean crushers or unsound vats is considerable no practical amount of pure yeast will have any effect. The addition of too large a volume of starter should be avoided, as it may produce too rapid and violent fermentation, which will be difficult to control even with cooling machines.

While the perfect sterilization of the grapes and must is at present impracticable and unnecessary, the number of foreign germs present should be kept as low as possible. Sufficient freedom from such germs is obtained in the manufacture of white wine by settling, sulphuring, or other means of defecating the must.

In the heat-extraction method of making red wine (see Bulletin 177) the partial sterilization due to the heating accomplishes the same end. With the ordinary method of making red wine this end can be compassed only by the most minute attention to cleanliness and other means of preventing the entrance of undue numbers of germs into the crushed grapes. If grape boxes, crushers, carriers, pumps, chutes and vats are never washed and are coated with must and grape skins, they serve as propagating grounds for yeasts and germs of all kinds. Piles of dry pomace outside the cellar or scattered on the surrounding roads, supply the air with myriads of bacterial spores. Vats of grapes exposed to these agents of infection cannot be influenced by a few buckets of pure yeast.

Directions for Use of Pure Yeast.

For 1000 gallons of crushed grapes or of must.

Materials needed:

1.—A 3-oz. flask of pure tested wine yeast.

2.—Half a gallon of sterilized must, about 10% Balling, in a one-gallon demijohn.

3.—Ten gallons of defecated must in a 25-gallon tub furnished with a good cloth cover.

4.—A room comparatively free from dust. (For example a moist cellar.)

Method of Procedure.

First Day.—Squeeze out a quart of must from clean, fresh grapes. The grapes should not be over-ripe. Mix the must with a quart of boiled water and place the mixture in a sterilized one-gallon demijohn. The demijohn should be sterilized by thorough cleaning, and heating for an hour in an oven or rinsing with a pint of 10% sulphuric acid and final rinsing two or three times with boiled water. After placing the diluted must in the demijohn close the latter with a firm plug of cotton wool (surgeon's cotton). Place the demijohn in a deep covered pan containing water such as an ordinary kitchen wash boiler and heat to boiling for one hour and then put aside to cool. Do not remove cotton plug.

Second Day.—1. Pour a few drops of alcohol onto the cotton plugs and necks of the pure yeast flask and the must demijohn and immediately set fire to the alcohol. This will destroy any spores which have settled with the dust on the plugs and necks. After shaking the pure yeast flask thoroughly pull out the plug and pour the contents into the must demijohn.

Replace the plug of the demijohn and shake for two minutes in such a manner as to aerate the must. Repeat this shaking three times a day.

Place the demijohn in a warm room where the temperature varies as little as possible.

2. Defecate 10 gallons of must from clean, fresh grapes containing not over 22% Balling.

The most convenient method of defecation is by the use of the sulphur tapes commonly used in cellars. In a 12 to 15 gallon keg burn as much sulphur as the air present will consume. (This is about ¼ of an ounce.) Then pour about 4 gallons of perfectly fresh must into the keg, bung up and roll for 5 minutes to make the must absorb the sulphur fumes and finally fill the keg with must, taking care to mix the treated with the untreated must. This will prevent any commencement of fermentation for two or three days, if the must is kept in a fairly cool place.

Chock the barrel so that it will remain steady and allow the impurities of the must to settle.

Third or Fourth Day.—In from 48 to 72 hours the must in the demijohn should be in full fermentation and the must in the barrel should be perfectly clear. Draw off the clear must, with a hose sterilized in hot water, into the 25-gallon tub which should also have been well scalded. Pour the fermenting must from the demijohn into the must in the tub and thoroughly aerate the mixture by dipping out some of the must with a quart dipper and pouring through the air back into the tub. This should be repeated three or four times a day, or oftener if fermentation is slow in starting. Fifteen or twenty quarts should be poured over in this way each time.

The tub of fermenting must should be kept in a warm room as free as possible from draughts and dust. It should be kept carefully covered between the aerations, to exclude dust.

Sixth or Seventh Day.—In from 48 to 96 hours after starting, the must in the tub should be in violent fermentation, and is then ready to use to start the regular fermentations. The volume of starter used should be about 1% of the volume of the grapes or must to be fermented.

If used for white wine, simply pour the proper quantity of starter into the cask before pumping in the must. If used for red wine, the starter should be distributed through the vat of crushed grapes by pouring in a little at a time as the vats are being filled.

If it is desired to ferment more than a thousand gallons with pure yeast, special directions will be furnished by the Station on request. Very satisfactory results can be obtained simply by starting new vats or casks with 1% of fermenting must from one of the first fermentations, which have been started with pure yeast, when it is in full action.

UNIVERSITY OF CALIFORNIA PUBLICATIONS.

COLLEGE OF AGRICULTURE.

AGRICULTURAL EXPERIMENT STATION,

BERKELEY, CALIFORNIA.

GRAPE CULTURE IN CALIFORNIA.

(ITS DIFFICULTIES; PHYLLOXERA AND RESISTANT VINES;
OTHER VINE DISEASES.)

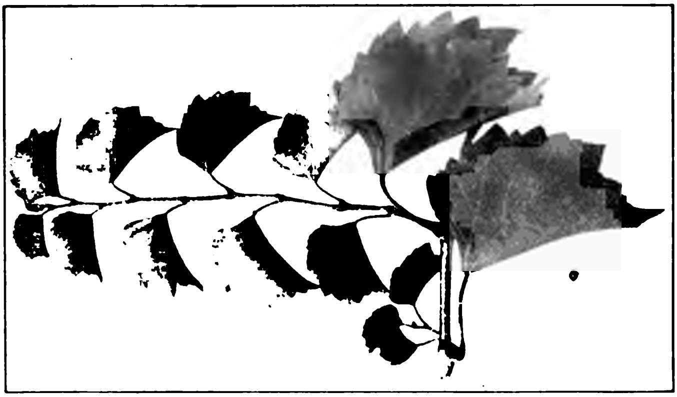
BY FREDERIC T. BIOLETTI.

IMPROVED METHODS OF WINE MAKING.

BY FREDERIC T. BIOLETTI.

YEASTS FROM CALIFORNIA GRAPES.

BY HANS C. HOLM.



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GRAPE CULTURE IN CALIFORNIA.

By F. T. BIOLETTI.

WORK OF THE STATION.

The growing of grapes and the industries based thereon are in a peculiar sense Californian. California produces, approximately, all the raisins, three quarters of the wine, and a large share of the shipping grapes of the United States.

All these industries have increased in importance with a steady and healthy growth during the last thirty or forty years, and during the last ten years the increase has been about 75%. The new plantations have been particularly numerous and extensive during the last five years. At present there are over 200,000 acres of vineyard in the State, and the prospects of continued expansion are favorable.

The growing of grapes has many practical and sentimental attractions both for capitalists and small farmers. No other branch of agriculture offers more certainty of steady, profitable returns for invested capital, and none offers superior inducements to the owner of a few acres of land in his effort to make a pleasant and adequate living by his own labor.

There is very little of the arable land of California which is not capable of producing abundant crops of good grapes, and the future output will be limited only by the demand and extent of the market.

The very attractiveness of viticulture and the peculiar suitability of California for its development involve dangers which must be avoided if we are to reap the best results from our advantages. A very large proportion of our new arrivals and settlers engage in some branch of grape-growing. Most of them have no knowledge of the business, or have preconceived ideas which are incompatible with our conditions. These conditions are so different from those of the Eastern States, and even from those of most of the grape-growing regions of Europe, that grape-growers from New York, Bordeaux, Burgundy or the Rhingau often fail to obtain better results than those who have had no previous practical experience in cultivating the vine.

In spite of California's superb advantages as a grape-growing region, statistics show that our average crop per acre is considerably less than that of Algeria or many parts of the south of France, and is hardly superior to that of Burgundy or the Rhingau. On the other hand, the crops on our best vineyards, vineyards which are handled properly, with due regard to our special conditions, are unexcelled anywhere in the world.

Two things, therefore, are urgently needed. First, the diffusion of special viticultural and enological knowledge, and second, the scientific and practical investigation of our peculiar problems. Since 1876 the Agricultural College at Berkeley has given more or less attention to the work of instruction and research in viticulture. At first Prof. E. W. Hilgard conducted this work almost single-handed, and, as in so many other departments of agriculture, laid the solid foundations which have contributed so much to the improvement of our cultural methods. From 1880 to 1894 the Viticultural Commission did much to instruct our grape-growers and wine-makers in the theory and practice of their arts.

Since 1894 the only institution in California—in fact, in the United States—which has given special attention to viticulture has been the Agricultural College and Experiment Station of the University of California. The work has been carried on somewhat spasmodically, owing to the lack of regular appropriations. At some sessions of the Legislature provision has been made for this purpose; at others it has been omitted.

This uncertainty of support makes much of the work which ought to be done impossible, and all of it more difficult. Experiments are commenced, observers are trained, but, before the most valuable results are obtained, the work has to cease for lack of funds. When a new appropriation is made, new observers have to be trained and much of the experiment work has to be recommenced. This results in loss of time and efficiency and a much smaller output of valuable information than would be possible if there could be more continuity in the work.

The Legislature of 1905 set aside $10,000 for the furtherance of viticultural research during the two years commencing July 1, 1905, and a considerable amount of progress has been made.

Besides the work of investigation carried out under the provisions of the bill passed by the last Legislature, the regular viticultural work of the University has been carried on. This work is, in the main part, educational. It consists of courses in grape-growing and wine-making to regular students, and short courses in the same subjects to special students. Short courses and viticultural institutes have also been given, so far as our time and resources have allowed, for the benefit of those actually employed in the industry.

The short courses at Berkeley to grape-growers and wine-makers actively engaged in the occupations have not been a success, owing to the small number who have been able to leave their work long enough to attend them. The special viticultural institutes, on the other hand, have met with a success that is very encouraging.

These institutes are given, so far as possible, in any viticultural center wherever a sufficient demand is manifested and the traveling expenses of speakers is borne by the Farmers' Institute appropriation. They last either one or two days, usually Saturday, or Friday and Saturday. They are not only confined strictly to viticulture, but attempt to treat only one particular part of this subject. The part chosen is, so far as practicable, one of actual interest at the season when the institute takes place.

The plan adopted is to accompany the lectures by practical demonstration in the vineyard. Two or three hours in the morning are usually all that are devoted to lectures. The afternoon is spent in the vineyards, where the ideas developed in the lectures are put into practice. An evening session is sometimes held to discuss the work of the day or to treat some subject unsuited to field demonstration.

An attempt is always made to adapt the instruction to the immediate needs of the locality and season, and to the time available. The principal topics which so far have been taken up at these viticultural institutes are the following:

1. Starting a new vineyard.
2. Pruning table grapes.
3. Pruning wine grapes.
4. Pruning raisin grapes.
5. Pruning young vines.
6. Oidium of the vine and methods of control.
7. The phylloxera of the vine.
8. Resistant vines.
9. Methods of grafting.
10. New varieties of grapes.
11. Fertilization of vineyards.

Another important phase of the viticultural activities of the University consists in an ever-increasing correspondence with grape-growers and wine-makers. Advice is given, suggestions made, and, where practicable, vineyards and cellars are visited on request.

Perhaps the most effective part of our work at present consists of spreading the knowledge, gained in the older districts by veteran growers, among new arrivals and in new districts. The repetition of costly mistakes is thus often prevented. More of this work should be done, but the small number of observers and experts prevents very great expansion at present. Instead of two or three trained viticulturists, the extent of California and the magnitude of its industries require a dozen. It is to be desired that an efficient expert, trained in the science and practice of grape-growing and wine-making, should be stationed in every large viticultural section, ready to advise all who apply. The expense would be compensated a hundredfold by preventing the frequent repetition of many costly mistakes. Easily avoidable loss of hundreds of thousands of dollars occur every year through ignorance of the best methods of pruning, grafting, sulfuring, fermenting, packing, and all the various operations of the vineyard and cellar.

Men suitable for such work in California are difficult to find. It requires an amount of practical experience and technical training which few possess. These requirements must, moreover, be coupled with personal qualifications of industry and judgment that make their possessors too valuable in other pursuits to make it possible to retain them unless they can be assured continuous employment at good salaries.

Publications of the Viticultural Department.—In the period of three years from January 1, 1905, to December 31, 1907, ten bulletins and five circulars have been published by the Viticultural Department. These represent the principal portion of the work which has been so far completed as to be of immediate use to growers and wine-makers. Minor topics and incomplete investigations are discussed shortly in the present bulletin.

PHYLLOXERA.

This vine disease is well established now in nearly every large grape-growing section, except those of southern California. There are still large areas of vineyard, however, in the San Joaquin and Sacramento valleys which have thus far escaped the pest. The slowness with which it has spread in these regions is remarkable when we compare it with the rapidity with which vineyards were attacked and destroyed in Europe, and also in Sonoma, Napa, Santa Clara and other of the coast counties.

There are several obvious reasons which account in part for this slow extension. The various grape-growing districts are scattered throughout a wide plain, more or less isolated from each other by miles of grain or pasture lands.

Many of the vineyards are planted in sandy soil, where the progress of the pest is always slow. The natural power of resistance to this disease possessed by the Flame Tokay, though not sufficient alone to save it permanently, is no doubt a factor in saving vineyards of this variety from rapid destruction. There seems some reason to believe that this variety under special conditions, when growing in deep, rich soil, especially if somewhat sandy, might be kept sufficiently vigorous by careful cultivation and fertilization indefinitely. It would be unsafe to trust to this for immunity, however, unless the vineyard were situated where it could, if necessary, be given a winter submersion of three or four weeks every few years.

It is a mistake to suppose, however, that rich soil or ordinary irrigation give any practical degree of immunity. Vineyards in the richest and most copiously irrigated regions of the San Joaquin Valley have already been destroyed by the pest. What the effect of alkaline soil has in this respect is as yet undetermined.

When we have made every allowance for the known factors which operate to delay the spread of the Phylloxera in the great central valleys of California, they do not seem sufficient to completely account for its slowness. Even the fact that the vineyards and wine-growing regions are widely separated by fields where no vines grow is insufficient to account for the slow spread of the insect, when we know that the winged form may be transported by the wind 20 or 30 miles and still infect the vine on which it is deposited.

The most plausible theory seems to be that the winged form is absent or extremely rare in the interior of California. In fact, the winged form is produced most abundantly on American species of vines, growing in cool, moist situations, and especially when rains occur in June and July. As such conditions never occur in the interior valleys, it is not strange that the winged form should be rare. No record exists of winged individuals having been seen in California except in the coast valleys.

If this theory is correct, the only means the insect has of spreading from one vineyard to another in the great valleys is by crawling from vine to vine or by being carried on cuttings or roots. This makes the delay of the extension of the pest by proper quarantine measures particularly useful and effective.

These measures are of two kinds—those which can be carried out by each grape-grower himself, and those which require the enforcement of ordinances by quarantine officers. The first are as important and more generally practicable than the last.

If no winged insects occur there is no danger of introducing the pest on cuttings, for these never carry the root form. As their absence. however, is not proved anywhere, and as cuttings may come from regions where they do exist, it is the part of wisdom to disinfect all cuttings before planting.

Disinfection of Cuttings.—The easiest and most effective method for the use of the grape-grower is by means of bisulfid of carbon.

The method of using the bisulfid is as follows: Place the cuttings in a barrel or vat or a box made tight by means of a thick coat of paint or of paper pasted on the inside. On top of the cuttings place a saucer or other shallow dish, into which to pour the bisulfid of carbon. An ordinary saucer will hold enough for a box of 27 cubic feet or a 200-gallon vat. For larger receptacles it is better to use two or more saucers. Deeper vessels will not do, as the evaporation is not sufficiently rapid. After pouring the bisulfid into the saucer, cover the box with an oiled canvas sheet or other tight-fitting cover, and allow to stand for from forty-five to ninety minutes. At the end of this time there should be a little of the bisulfid left. If it has all evaporated this is proof that insufficient was used. No flame lights should be used, as the liquid burns easily and the fumes form an explosive mixture with the air. Lately, in Switzerland, a cellar was wrecked and a man killed by an explosion of vapors of bisulfid owing to a neglect of this precaution. Care should be taken not to spill any of the liquid on the cuttings, as it may kill them. It is advisable to cut off about half an inch of the lower end of the treated cuttings before planting, as the vapor injures the open pith.

Besides disinfecting the cuttings in this way, all the packing material in which they come should be burnt, or, if valuable, dipped in boiling water. Practically, it is impossible to disinfect rooted cuttings by this means satisfactorily on account of the difficulty of killing all the Phylloxera without seriously injuring the vine roots.

Disinfection of Roots.—For the disinfection of rooted vines dipping in hot water is recommended by the best European authorities. The roots should remain in water at 125°F. to 130°F. for ten minutes. The same treatment may be used for cuttings. The method has several inconveniences, however. Only small quantities can be disinfected at one time, and it requires great care to see that, on the one hand, the heating is sufficient to kill the insects, and, on the other, not sufficient to injure the vines. Experiments with this method by the University are not promising, and many of the rooted vines were killed.

It is probable that disinfection by means of hydrocyanic gas as practiced for nursery stock would be effective, but data is lacking on this point.

Delaying the Spread of Phylloxera.—When the Phylloxera has entered the vineyard it can not be found until it has increased sufficiently to kill or seriously weaken a vine. By this time it has usually spread to at least several neighboring vines. It is usually hopeless to attempt to eradicate it in this case without digging up and destroying a very large number of vines, and even in this case there is no assurance that other infected spots do not exist. Something, and in some cases, much, however, can be done to delay its spread, and the main part of a vineyard may often be preserved for many years by proper measures.

The first thing to be done when infection is first discovered is to dig up all the dead and weakened vines and a block surrounding them, including at least three rows of apparently healthy vines on all sides.

These vines should be all burned on the spot or piled up in the center of the infested block, sprayed with coal oil, and left for several months until the dry summer air has certainly killed all the insects on their roots. A more effective method is to treat the infested area with enough bisulfid of carbon to kill both the vines and the Phylloxera. This is done by making holes with a crowbar 12 inches deep every 18 inches over the whole area. Into each hole is poured 1½ ounces of bisulfid and the hole closed immediately with the foot. This treatment is best applied in April or May, after the vines have started and before the ground becomes too dry. If any vines survive this treatment, a new dose of 1 ounce to the 18 inches should be applied three weeks later.

However carefully either of these methods is carried out it affords only temporary relief. In Switzerland, Algeria, and Germany, where such methods have been applied with the utmost strictness and under military supervision, the spread of the pest has been checked but not stopped.

In any case, plows or cultivators should not pass through affected spots in the healthy parts of the vineyard. Cultivation is one of the most effective means of carrying the root insects from one part of the vineyard to another.

Every effort should be made to discourage the introduction of cuttings, and especially of roots, from infested to uninfested districts. Wherever possible it is best to obtain planting stock in the immediate neighborhood.

Reëstablishment of the Vineyard.—When a vineyard becomes thoroughly infested, that is, when it contains several scattered, diseased spots, or when 10% to 15% of the vines are known to be attacked, it is useless to attempt to delay the pest by these means. The only course to be followed in this case is to cultivate each block as long as it produces paying crops, and then to dig it up and replant it with bench grafted resistants. It is very bad policy to commence replanting single vines or small areas each year as they fail. A young resistant planted among old viniferas never gets the proper care, and has no chance to do its best. Where this method is adopted, the vineyard finally becomes a mixed lot of vines of various ages and of various degrees of unprofitableness. Replanting should be done in regular, rectangular blocks.

Planting New Vineyards.—In planting a vineyard in new soil, whether we should plant grafted resistants or viniferas on their own roots is to be determined by local conditions. If there is great likelihood of our vines being attacked before they have borne two or three crops it would be folly to plant anything but resistants. Hundreds of acres, in the aggregate, which have been planted in Phylloxera-infested districts have died before they ever produced a crop. On the other hand, if there is a fair chance of the vineyard remaining uninfested for many years it is often safe to plant non-resistants, and thus save the $30.00 to $40.00 per acre extra which a resistant vineyard will cost.

In the counties of Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, Santa Cruz, and San Mateo, where the Phylloxera is very generally distributed, it is throwing work away to plant anything but resistant vines. The same is true of those districts in the Sacramento and San Joaquin valleys where the pest has obtained a secure foothold. In any district it is unsafe to plant non-resistants anywhere within two or three miles of an infested vineyard.

RESISTANT VINES.

The demand for information regarding Phylloxera-resistant vines becomes every day more pressing. The problems of the adaptation of various stocks to various soils and climates, of the suitability of various combinations of stock and scion, and of the best methods of grafting have, therefore, been given as much attention as possible.

Rupestris St. George.—Probably nine tenths of the resistant vines being planted in California at the present time are Rupestris St. George. This is undoubtedly a most excellent stock for a large portion of the country. It is giving its best results in the interior valleys and in the warmer parts of the coast valleys and hillsides. Numerous cases of partial failure, however, have been noted, which make it certain that for many locations a better stock is to be found.

Most of the cases of failure have been reported from Sonoma, Napa, and Santa Clara counties. They can nearly all be traced to unsuitable soil conditions. Where there is an impermeable subsoil (bed rock or compact clay) the St. George usually fails. Under such conditions, if the soil is dry, the vines make poor growth; if wet, the roots decay and the vines die. A very compact clay soil, even when deep, seems unsuited to this variety, at least when grafted with certain varieties, such as Emperor and Cornichon.

In some cases the vines grow well, but the crops are unsatisfactory. This has been noted only in rich valley soil of the coast counties and only with certain varieties. A similar condition has often been noted in Europe, but it is usually easily overcome by longer pruning and diminishes with age.

A more serious defect has been found in some of the cooler districts. Many varieties when grafted on St. George ripen from one to two weeks later than when grafted on Riparia and some other stocks. This is due, probably, to the great vigor of the stock, which keeps the vine growing late. It is a serious defect wherever there is difficulty in obtaining the desired amount of sugar in the grapes and wherever late grapes are liable to injury from the autumn rains.

It seems inadvisable, therefore, to plant St. George in cool situations, on northerly slopes of the coast ranges, in localities close to the coast, or on shallow, wet, very rich or stiff clay soils in any locality, and to use it only on deep, permeable soils in the warmer districts and locations.

EXPERIMENTS WITH VARIOUS STOCKS.

Through the courtesy of Mr. J. K. Moffit we have been able to take some very interesting notes on resistant vines at an experiment plot in his vineyard at St. Helena, Napa County.

This plot was planted in 1900, under the direction of the Experiment Station, with the resistant stocks and bench grafts which served for the experiments detailed in Bulletin 127. Since that time it has been looked after by Mr. B. Bruck, the manager of the vineyard. The following is a summary of the notes taken in 1905.

Three rows of 25 vines each were planted with various varieties of bench grafts; in one row the stock being Rupestris St. George, in another Riparia Gloire, and in the third Riparia Grande Glabre. In most cases there were two vines of each variety on the same stock, in some cases three, and in some only one. The results are, therefore, not quite so convincing as if they had been made on a larger scale:

Bench Grafted Vines. Planted in 1900.

Notes taken in 1905.

SCION.	Stock.	Growth in May.	Crop.	Remarks.
Kleinberger	Rip. gloire	Heavy	Poor	Much broken by wind.
Kleinberger	St. George	Heavy	None	Nearly all canes blown off.
Sultana	Rip. gloire	Strong	Good	Berries very large.
Sultana	St. George	Strong	Fair	Berries smaller than on Rip.
Blue Portuguese	Rip. gloire	Fair	Good.	
Burger	Rip. gloire		Very large	23 pounds to one vine.
Pinot Chardon'y	Rip. gloire	Fair	Good.	
Pinot Chardon'y	St. George	Very strong	Fair.	
Semillon	Rip. gloire	Strong	Large.	
Palomino	St. George	Very strong	Large.	
Valdepeñas	Rip. gloire	Very strong	Very large	22 pounds to one vine.
Valdepeñas	St. George	Very strong	Poor.	
Gros Mansenc	Rip. gloire	Fair	Heavy.	
Gros Mansenc	Rip. gr. glabre	Strong	Fair.	
Folle blanche	Rip. gloire	Strong	Very large	25.5 pounds to one vine.
Fresa	Rip. gloire	Fair	Fair.	
Fresa	Rip. gr. glabre	Strong	Fair.	
Marsanne	Rip. gloire	Strong	Fair.	
Marsanne	Rip. gr. glabre	Strong	Large.	
Marsanne	St. George	Fair	Fair.	
Vernaccia	Rip. gloire	Strong	Large.	
Vernaccia	Rip. gr. glabre	Very strong	Fair.	
Vernaccia	St. George	Strong	Fair.	
Cornichon	Rip. gr. glabre	Fair	Fair.	
Cornichon	St. George	Very strong	Good.	
Aramon	Rip. gr. glabre	Strong	Good	22.5 pounds to one vine.
Mataro	Rip. gr. glabre	Weak	Good.	
Mourisco preto	Rip. gr. glabre	Very strong	Fair.	
Huasco	Rip. gr. glabre	Fair	Fair	Much coulure.
Sultanina	Rip. gr. glabre	Very strong	Poor.	
Verdot	Rip. gr glabre	Very strong	Good.	
Barbera	St. George	Very strong	Large.	
Beba	St. George	Very strong	Good	Berries very small.
Mantuo	St. George	Very strong	Fair	Berries very small.
Franken Riesl.	St. George	Very strong	Small	Much coulure.
Alicante Bous.	St. George	Very strong	Very large.	
Perruno	St. George	Very strong	Large.	

In a general way, all the varieties on all stocks looked sufficiently vigorous, with the exception of the Mataro on Riparia Grande Glabre. The vines on St. George were nearly always more vigorous than those on Riparia. Of the two Riparias the Grande Glabre seemed a little the more vigorous. The relative standing of the three stocks with regard to vigor is indicated in the following summary:

Comparison of Vigor of Vine on Various Stocks.

VIGOR.	Number of Varieties on—		
	Riparia Gloire	Riparia Grande Glabre.	St. George.
Very strong	2	5	11
Strong	5	3	2
Fair	4	2	1
Weak	0	1	0

The only variety which looked very weak was the Mataro on Rip. Grande Glabre. This corresponds with European experience where it is recommended to graft this variety only on vinifera × American hybrids, such as Aramon × Rupestris No. 1 and Mourvèdre × Rupestris 1202. Where the growth is marked "fair" the slight lack of vigor could generally be ascribed in part to the heavy crop. Exceptions to this are the Cornichon and Huasco (Muscat of Alexandria), which not only lacked vigor but also crop on Riparia.

The bearing on the various stocks may be compared in the same way in the following summary:

Comparison of Crops on Various Stocks.

CROP.	Number of Varieties on—		
	Riparia Gloire.	Riparia Grande Glabre.	St. George.
Very large	4	0	1
Large	2	1	3
Good	3	3	2
Fair	2	6	5
Small	1	1	3

This is hardly a fair comparison, for the reason that in most cases the same variety was not grafted on all three stocks. In all cases, however, where the same variety was grafted on both Riparia and Rupestris St. George, with the exception of the Cornichon and Fresa, the vines on Riparia had larger crops. This is shown by the following comparison:

Comparison of Crops on Riparia and Rupestris.

VARIETY.	Crop of Vines on—	
	Riparia.	Rupestris St. George.
Kleinberger	Poor	None.
Sultana	Good	Fair.
Chardonay	Good	Fair.
Valdepeñas	Very large	Poor.
Gros Mansenc	Heavy	Fair.
Fresa	Fair	Fair.
Marsanne	Fair to large	Fair.
Vernaccia	Fair to large	Fair.
Cornichon	Fair	Good.

It should be noted that all varieties indiscriminately were pruned short. If those which need long pruning when ungrafted had been pruned long, the showing would undoubtedly have been more favorable to the St. George. It is a very valuable characteristic of the Riparia, however, that it enables us to obtain good crops with short pruning from varieties which on their own roots require long pruning. This is exemplified in table on page 124 by the fact that of eleven varieties which ordinarily require long pruning eight varieties bore good crops with short pruning when grafted on Riparia; of seven long-pruning varieties grafted on St. George, only one bore good crops when pruned short. This was especially noticeable with the Valdepeñas and Gros Mansenc, which bore very fine crops on Riparia Gloire and very little on St. George.

The only long-pruning variety which bore well on St. George was the Barbera. Of the short pruning varieties the following bore well on St. George: Palomino, Alicante Bouschet, Perruno, and Cornichon.

The quality of the grapes was in nearly all cases, where a comparison was possible, better on Riparia stock than on St. George. The grapes were larger and sweeter. The higher sugar content was, moreover, usually accompanied by higher acidity, showing that the grapes were better developed. The following table includes varieties which were bearing on both Riparia and St. George, and shows very clearly the superiority of the former stock in regard to the quality of the must:

Analysis of Grapes from Grafted Vines.

St. Helena Plot. October 6, 1905.

SCION.	Stock.	Sugar.	Acid.	Remarks.
Valdepeñas	Rip. gloire	27.5	.65	Very ripe, a few grapes shriveled.
Valdepeñas	St. George	23.5	.56	Crop very small.
Zinfandel	Rip. gloire	26.5	.92	
Zinfandel	St. George	24.0	.85	Many dried grapes.
Aramon	Rip. gr. glabre	18.2	.96	Grapes small for Aramon.
Mourisco preto	Rip. gr. glabre	23.0	.66	
Blue Portuguese	Rip. gloire	32.2	.53	Much overripe.
Mataro	Rip. gr. glabre	19.0	.75	
Gros Mansenc	Rip. gr. glabre	26.7	1.12	
Gros Mansenc	Rip. gloire	24.1	1.20	
Fresa	Rip. gr. glabre	24.0	.83	
Fresa	Rip. gloire	26.6	.92	
Alicante Bouschet	St. George	18.2	.86	
Barbera	St. George	26.1	.87	
Marsanne	Rip. gr. glabre	25.0	.67	
Marsanne	Rip. gloire	23.3	.50	
Marsanne	St. George	21.6	.62	
Chardonay	Rip. gloire	25.0	.60	
Chardonay	Rip. gr. glabre	22.8	.87	
Semillon	Rip. gloire	26.5	.68	
Huasco	Rip. gr. glabre	27.1	.64	
Palomino	St. George	26.5	.55	
Palomino	St. George	29.0	.45	
Kleinberger	Rip. gloire	22.6	1.12	
Perruno	St. George	23.4	.47	
Franken Riesling	St. George	26.5	.59	
Sultana	St. George	24.7	.75	
Sultana	Rip. gloire	24.0	.75	
Mantuo	St. George	27.1	.39	Many small grapes.
Beba	Rip. gr. glabre	20.3	.41	Grapes very small.
Cornichon	Rip. gr. glabre	20.3	.77	
Cornichon	St. George	18.4	.65	Grapes very fine.

Comparison of Composition of Grapes on Riparia and St. George.

VARIETY.	STOCK.					
	Riparia Gloire.		Riparia Grande Glabre.		St. George.	
	Sugar.	*Acid.*	*Sugar.*	*Acid.*	*Sugar.*	*Acid.*
Valdepeñas	27.5	.65			23.5	.56
Zinfandel	26.5	.92			24.0	.85
Gros Mansenc	24.1	1.20	26.7	1.12		
Fresa	25.6	.92	24.0	.83		
Vernaccia	27.5	.84	27.6	.92	24.2	.61
Marsanne	23.3	.50	25.0	.67	21.6	.62
Chardonay	25.0	.60	22.8	.87		
Sultana	24.0	.75			24.7	.75
Cornichon			20.3	.77	18.4	.65
Mean	25.4	.80	24.4	.86	22.7	.67

These observations warn us that we should not hastily reject the Riparia as a stock. While there have been many failures on Riparia, these failures can be traced to lack of selection of the proper kind of Riparia and to the planting of Riparia on unsuitable soil. If we plant Riparia Gloire on rich, deep, loose, moist but well-drained soil, especially in the cooler districts, and avoid overbearing by too long pruning, we will probably obtain better results than by planting Rupestris St. George under the same conditions.

Zinfandel.—A very interesting part of the plot is a series of rows of different stocks field-grafted in 1900 with Zinfandel. Each row consisted of about 20 vines. A summary of the notes taken is given in the following table:

Notes on Zinfandel Grafted on Various Stocks.

Vines 5 years from grafting. 1905. St. Helena.

STOCK.	GROWTH.			Crop.	Remarks.
	May.	Aug.	Sept.		
Rupestris Martin	Vigorous	Good		Large.	
101^{14}	Vigorous	Fair	Strong	Good	Looked a little weak in August, but recovered.
Rupestris St. George	Vigorous	Good		Good	Sugar 24.0, acid .85, many dried grapes.
3309	Good	Fair	Strong	Heavy.	
101^{14}	Vigorous	Fair	Strong	Heavy	More vigorous than 3309, less than St. George.
Viala	Uneven	Weak	Fair	Fair	Vines all weakly.
Riparia Gloire	Strong		Fair	Good	Sugar 26.5, acid .92.
Solonis	Weak	Fair	Fair	Large	Growth uneven.
Rupestris Mission	Fair	Fair	Fair	Good.	
Munson	Strong		Good	Good.	
Riparia Grande Glabre			Fair	Fair.	

It is encouraging to find that our principal wine grape has given good results on all the principal stocks. The vigor and bearing of the vines on Riparia × Rupestris 3309 and 101^{14} were particularly fine.

Mondeuse.—One of the rows of this variety is grafted on Riparia Grande Glabre and is very vigorous and bearing good crops. About 600 vines of the same variety are grafted on St. George and are even more vigorous, but the crop is uneven. Owing to the vigor of the growth many canes were broken by the wind in the spring, which probably accounts for the variations in bearing. All the vines show a considerable amount of coulure.

Semillon grafted on St. George made good growth, but the crop was unsatisfactory and much coulured.

Ferrara on St. George (about 75 vines) showed excellent growth, but only a medium crop and much coulure.

Tokay on St. George (50 vines) was excellent. The vines were extremely vigorous and the crop good. The bunches were not compact, but were well filled. The tendency of the stock to produce coulure in this case had resulted simply in a thinning of the berries, which was an advantage.

St. Macaire on St. George has done very well, being vigorous, and producing good crops with short pruning.

Bench Grafts and Field Grafts.—In starting this experiment plot some of the rows were planted with bench grafts and the others with rooted resistants, which were field-grafted the following year. This gives us a good comparison of the two methods as regards the securing of a good stand.

Comparison of Bench Grafting and Field Grafting.

Stocks.	No Growing 5th Year.	No Failed by 5th Year.
FIELD GRAFTING (Zinfandel)—		
Rupestris St. George	39 = 68%	18 = 32%
Riparia × Rupestris 3309	36 = 72%	13 = 28%
Riparia × Rupestris 101^{14}	42 = 84%	8 = 16%
Rupestris Martin	26 = 55%	21 = 45%
Vialla	16 = 70%	7 = 30%
Total	159 = 70%	67 = 30%
BENCH GRAFTING—	No. Growing 6th Year.	No. Failed by 6th Year.
Mondeuse on St. George	600 = 98%	14 = 3%
Tokay on St. George	48 = 96%	2 = 4%
Ferrara on St George	70 = 93%	5 = 7%
Total	718 = 97%	21 = 3%

As all these vines were growing close together on the same kind of soil, and under the same management, the comparison speaks eloquently in favor of bench grafts as a means of obtaining a perfect "stand."

EXPERIENCE OF GROWERS. WINE GRAPES.

An attempt has been made to collect the experience with various resistant vines of growers in various sections. The experience of the older vineyards is of little use, and, in fact, apt to be misleading, as they were nearly all grafted on unselected Riparia and Rupestris. The stocks in the newer resistant vineyards are nearly all Rupestris St. George and Lenoir, so that the data for comparison are meagre. Some of the reports received, however, are interesting and are given here.

NAPA COUNTY.

B. Bruck, St. Helena.

	Vigor.	Crop.
Zinfandel on St. George, 7 years old, red, clay, hill soil	Good	Fair
Zinfandel on Lenoir, 8 years old, red, clay, hill soil	Good	Fair
Burger on St. George, 9 years old, rich, dry soil	Good	Large
Palomino on Lenoir, 9 years old, rich loam	Good	Good
Carignane on Lenoir, 8 years old, rich loam	Fine	Fine
Sauvignon vert on Riparia, 14 years old, rich loam	Fine	Fine
Sauvignon vert on St. George, 5 years old, rich loam	Fine	Fair
Johannisberger on Riparia, 10-14 years old, loamy soil	Fine	Fair
Johannisberger on St. George, 6 years old	Strong	Poor
Tokay on St. George, 7 years old, heavy soil	Good	Fair
Tokay on Lenoir, 8 years old, gravelly soil	Fair	Fair
Muscat on Lenoir, 8 years old, dry, gravelly	Weak	Good

The vineyard to which these notes refer is the same as that in which the experiment plot, reported on above, is situated. The results corroborate these of the plot. The crops of varieties grafted on St. George vary from poor to fair, with the exception of the Burger, whose natural tendency to heavy bearing has here been retained when grafted on St. George.

J. H. Wheeler, St. Helena.

Zinfandel on St. George, 1-8 years old	Vigorous and satisfactory.
Zinfandel on Lenoir, 1-18 years old	Vigorous and satisfactory.
Zinfandel on Riparia	Poor, gradually dying.
Burger on Lenoir, 1-12 years old	Very vigorous, good crops.
Muscat on Lenoir, 10 years old	Fair.

Mr. Wheeler states that all varieties grafted on Lenoir yield about one half the crop which they formerly did when growing on their own roots, but that the crops are regular. The same varieties grafted on St. George yield from one half to two thirds the crops formerly obtained before the advent of Phylloxera. This report is sufficient to condemn both stocks for this vineyard, as the experience in Europe is that whenever a stock suitable to the variety of scion and the nature of climate and soil is used, the crop of grafted vines is always larger than that of vines on their own roots. There can be little doubt that the Riparia × Rupestris hybrids would give better results in this vineyard.

Mr. Wheeler states further that Lenoir gives late ripening and low sugar with all varieties, that the same varieties on St. George ripen about two weeks earlier and attain from 1% to 3% more sugar. These varieties on Riparia ripen still earlier (1 to 2 weeks) and attain 1% to 2% more sugar than on St. George. This corroborates the experience on the St. Helena plot.

Crabb's Black Burgundy (Refosco) and Petite Sirah are said to fail occasionally on St. George, but a second graft on the same stock usually takes. This simply indicates a slight difficulty in grafting, and not necessarily any lack of affinity.

Fred S. Ewer, Rutherford.

Mr. Ewer finds the Lenoir a very satisfactory stock, as is shown by the following extract from a letter which he kindly wrote:

> I would like to say, on the start, that my knowledge of the different resistant stocks (except Lenoir) is so limited that I shall not attempt to say much about any other than the Lenoir.
>
> I have tried only three different resistants in all, Riparia, Rupestris St. George, and Lenoir, and all grafting on same was field work, as I have never been a believer in bench work for our place, believing we could get a vineyard quicker with the field grafting, and the little bench grafting I have done has proved it to my entire satisfaction.
>
> The Riparia was a total failure with us at Rutherford, and a partial success at our small vineyard at St. Helena. We planted 3,000 Rupestris in vineyard, and grafted them at one year old, and only got a stand of 30%, where with the Lenoir we nearly always got from 90% to 95% of a stand, so you can easily see why I favor the Lenoir.
>
> Under certain conditions, such as soil, climate, moisture, etc., I am inclined to think, from the experience of others, that the Rupestris is better than the Lenoir, but not for our place.
>
> My preference for the Lenoir, summed up briefly, is as follows, viz.: Vigorous growers, ease of taking the graft, fine union, and few, if any, suckers, if properly prepared before planting.
>
> I will say that as regards the bearing of the different varieties on resistant stock, I believe we get a better crop and more sugar now than we used to on the vinifera; that is to say, on all varieties we have, such as Chas. Font, Golden Chasselas, Semillon, Sauvignon vert, Traminer, Burger of the white varieties, and Crabb's Black Burgundy, Alicante Bouschet, Petite Sirah, Beclan, and a few Zinfandel of the reds.
>
> I have Petite Sirah grafted on Lenoir fourteen years old, and growing strong and vigorous, and bearing good crops every year. I wish you could see the crop of grapes on them now; it looks like eight tons to the acre.
>
> I believe I am the only person in this county who has grafted any Muscat on Lenoir, and my foreman said the other day there were more grapes on the vines than leaves, showing that the Muscat will do well on Lenoir; they are now eight years old and doing well.

It should be noted that the soil of Mr. Ewer's vineyard is very deep, rich, and liable to become very wet in the winter. These conditions are very favorable to the growth of new roots, and, to some extent, unfavorable to the Phylloxera. This is shown by the fact that some Zinfandel vines, on their own roots, are still bearing good crops, though they have been infested with Phylloxera for ten years or more. Under such conditions, the low resistance of the Lenoir is sufficient. It would be unsafe to conclude from this that Lenoir would be sufficiently resistant in other soils and under other conditions.

The failure of Riparia, noted both by Mr. Ewer and by Mr. Wheeler, is in part due no doubt to the use of unselected stock. If Riparia Gloire had been used it is probable that very different results would have been obtained.

G. de Latour, Rutherford.

	Vigor.	Crop.
Zinfandel on St. George, 5 years old, gravelly soil	Not good	3 tons
Burger on St. George, 5 years old, gravelly soil	Very good	6 tons
Alicante Bouschet on St. George, 5 years old, gravelly soil	Good	4 tons
Palomino on St. George, 5 years old, gravelly soil	Very good	2 tons
Sauvignon vert on St. George, 5 years old, gravelly soil	Very good	2 tons
Green Hungarian on St. George, 5 years old, gravelly soil	Very good	5 tons
Petite Sirah on St. George, gravelly soil	Weak	Good
Grand Noir on St. George, 3 years old, gravelly soil	Good	1½ tons

Mr. de Latour states further "* * * it seems that Zinfandel does not succeed very well on St. George; the union with Petite Sirah seems defective also. The Riparia × Rupestris 3309 seems to be still better than the Rupestris St. George."

SONOMA COUNTY.

L. Justi, Glen Ellen.

Reports that all the varieties of wine grapes in his district have grown vigorously and borne good crops on Lenoir, with the exception of the Petite Sirah, which sometimes fails. Alicante Bouschet and Burger do particularly well.

K. Nagasawa, Santa Rosa.

Zinfandel on St. George, 5 years old, on light ashy soil, becoming very hard in summer, are very vigorous and yield very well. Alicante Bouschet, Beclan and Muscadelle du Bordelais on the same stock are doing well, though too young to bear yet.

SAN JOAQUIN COUNTY.

F. and F. A. Arnold, Stockton.

Nature of soil: 24 acres—3 parts adobe and 1 part river sand and slickens; 3 to 6 feet deep; no overflow for years; no irrigation. Plowed 12 inches deep before planting cuttings; field grafting. Burger and Mission doing well on Rupestris St. George, Riparia Gloire, Riparia Grande Glabre, and Riparia × Rupestris hybrids.

SANTA CLARA COUNTY.

Paul Masson, San José.

Zinfandel on Rupestris St. George, 6 years old, satisfactory, good unions, healthy looking, but do not bear abundantly.

Burger on Rupestris St. George, 4 to 7 years old, field grafted; bad. Poor success from beginning, many dying every year, apparently from poor unions and lack of affinity. Same results on sandy, deep, rich gravelly and rich loamy soils.

Carignane and Pinot, 11 years old, planted on special soil, are doing well.

"I have quite a few acres of 11-year-old vines grafted on Rupestris St. George, including the following varieties: Carignane Mondeuse, Alicante Bouschet, Aramon, Grand Noir, Durif, Grenache, Pinot. Semillon, Sauvignon vert, Folle blanche, Colombar, Pinot blanc. These are all doing very well, and, if anything, more vigorous and prolific than ungrafted vines of the same age. Carignane and Grenache, 12 years old on St. George, have never failed to give a large crop, and Aramon also seems very prolific."

Mataro (grafted) is not very satisfactory; it bears heavily, but many die during the hot summer.

Thos. Casalegno, Evergreen.

Zinfandel on St. George, vigorous; coulures.

Mondeuse on Riparia, fair vigor and crop.

St. Macaire on Riparia, 9 years old, rocky soil, light growth, fair crop.

Carignane on Riparia, 10 years old, good growth and crop.

Carignane on St. George, 10 years old, clay soil, good growth and crop.

Carignane on St. George, 10 years old, gravel soil, good growth, but coulures.

Mataro on St. George, 7 years old, coulures.

Mataro on Riparia, good growth and crop.

Alicante Bouschet on St. George, 5 years old, strong growth, coulures.

Palomino on St. George, 7 years old, clay loam, good growth and crop.

Chasselas on St. George, 7 years old, clay loam, good growth and crop.

ALAMEDA COUNTY.

Grau & Werner, Irvington.

Tannat on Lenoir, 13 years old, healthy growth, but very light crop.

SANTA CRUZ COUNTY.

E. E. Meyer, Wrights.

Valdepeñas, 7 years old, and Green Hungarian, 6 years old, grafted on St. George, are growing vigorously, but the crops are not altogether satisfactory.

Summary of Reports from Growers.

VARIETY.	Vigor.			Crop.		
Zinfandel on St. George	Good 5		Poor 1	Good 1	Fair 4	
Zinfandel on Riparia			Poor 1			
Zinfandel on Lenoir	Good 2				Fair 2	
Carignane on St. George	Good 3			Good 2	Fair 1	
Carignane on Riparia	Good 2			Good 2		
Carignane on Lenoir	Good 1			Good 1		
Alicante Bouschet on St. George	Good 3			Good 1	Fair 1	
Alicante Bouschet on Lenoir	Good 1			Good 1		
Petite Sirah on St. George	Good 1		Poor 1	Good 2		
Petite Sirah on Lenoir	Good 1		Poor 2	Good 1	Fair 1	
Mondeuse on St. George	Good 1			Good 1		
Mondeuse on Riparia		Fair 1			Fair 1	
St. Macaire on St. George	Good 1			Good 1		
St. Macaire on Riparia		Fair 1			Fair 1	
Valdepeñas on St. George	Good 1				Fair 1	
Durif on St. George	Good 1			Good 1		
Mataro on St. George			Poor 1	Good 1	Fair 1	
Mataro on Riparia	Good 1			Good 1		
Burger on St. George	Good 2		Poor 1	Good 2		
Burger on Lenoir	Good 2			Good 2		
Palomino on St. George	Good 2			Good 2		Poor 1
Palomino on Lenoir	Good 2			Good 2		
Johannisberg Riesl. on St. George	Good 1					Poor 1
Johannisberg Riesl. on Riparia	Good 1				Fair 1	
Semillon on St. George	Good 1			Good 1		
Semillon on Lenoir	Good 1			Good 1		
Colombar on St. George	Good 3			Good 1	Fair 1	Poor 1
Colombar on Riparia	Good 1			Good 1		
Colombar on Lenoir	Good 1			Good 1		
Green Hungarian on St. George	Good 1				Fair 1	
Grenache on St. George	Good 2			Good 1		

STOCKS FOR THE FRESNO REGION.

In 1903 five plots of resistant vines were planted in the neighborhood of Fresno on land kindly placed at our disposal for that purpose by various growers.

The great importance of the raisin and wine industries in the upper San Joaquin Valley, and the special climatic and soil conditions of that region, make it very necessary that we should, as soon as possible, obtain some reliable information regarding stocks that will succeed there. European experience can be relied on less in this region than in the coast valleys. No part of France resembles the San Joaquin Valley, and in the parts of Spain which show the most nearly similar conditions the problems of resistant stocks are hardly more advanced than in California.

The five plots were planted primarily to determine the vigor of the most promising stocks in the region, and to provide cuttings for distribution to enable growers to make tests on their own places.

The following varieties, which include nearly all those which have given the best results in Europe, were planted:

Pure American Varieties.

1. Riparia Gloire de Montpellier.
2. Riparia Grande Glabre.
3. Rupestris Martin.
4. Rupestris St. George.
5. Berlandieri Rességuier No. 1.

Americo-American Varieties.

6. **Riparia × Rupestris 3306.**
7. **Riparia × Rupestris 3309.**
8. **Riparia × Rupestris 101^{14}.**
9. **Riparia × Berlandieri 33E.**
10. **Riparia × Berlandieri 34E.**
11. **Riparia × Berlandieri 157^{11}.**
12. **Riparia × Berlandieri 420A.**
13. **Rupestris × Berlandieri 219A.**
14. **Rupestris × Berlandieri 301.**
15. **Solonis × Riparia 1615.**
16. **Solonis × Riparia 1616.**
17. **Riparia × Cordifolia-Rupestris 106^{8}.**
18. **Solonis × Cordifolia-Rupestris 202^{4}.**

Franco-American Varieties.

19. **Mataro × Rupestris 1202.**
20. **Aramon × Rupestris No. 1.**

As might have been expected, nearly all of these varieties which started grew vigorously in the rich soil of the region. Cuttings were used in making the plantations, and the plots show strikingly the differences in facility of rooting of the different stocks. The Berlandieri and Berlandieri crosses rooted badly. The best of the latter in this respect was the Riparia × Berlandieri 157^{11}.

The four most vigorous of the stocks were 1616, 1202, 3306 and St. George. All of these in all the plots grew with extraordinary vigor and rapidity.

Seven other varieties grew with scarcely less vigor. These were 3309, 101^{14}, 1615, Riparia Gloire, 157^{11}, Aramon × Rupestris No. 1, and 106^{8}. Four varieties, 33E, 34E, 202^{4}, and Rupestris Martin grew with fair vigor, but were distinctly inferior to the above.

The only varieties of the list which made poor growth were Riparia Grande Glabre, 219A and 301.

Stocks for Muscat.—The importance of the Muscat of Alexandria, as the basis of our raisin vineyards, makes it highly important that a suitable stock for this variety should be found as soon as possible.

The invasion of the raisin vineyards of Spain by Phylloxera is comparatively recent, and little information is obtainable regarding the use of resistant stock there. In a general way it is stated that the usual resistant stocks are being used in the principal raisin-growing regions of the Peninsula with success. The Muscat of Alexandria is being grown to a limited extent as a table grape in southern France, and is said to succeed on any vigorous stock.

On the other hand, in South Africa, Muscat vineyards grafted on Rupestris St. George, Riparia Gloire, Aramon × Rupestris No. 1, and Rupestris Metallica have almost uniformly failed. After bearing several good crops the vines have generally died. No satisfactory explanation of this difference has been advanced. The most plausible seems to be that the vines have been killed by overbearing. The vines, in fact, have borne large crops before dying, and the only stock on which they have remained healthy is Lenoir, which has a tendency to induce light bearing with most varieties.

The grafting of Muscats on resistant stocks has been little practiced in California, but a few growers have vines which have been bearing several years on various stocks.

One grower reports that Muscats on Lenoir, 10 years old, have given fair results; another that they are weak, but bear well. One grower in Tulare County has dug up his Muscat vineyard grafted on Lenoir because so many of the vines had died. Two growers report that they have Muscats grafted on St. George which have been bearing well and growing vigorously for from 3 to 6 years. Another grower reports that his Muscats grafted on St. George and on Riparia Gloire have given three good crops and are equally vigorous. These results are on the whole encouraging.

While the question of the selection of the best stock is not so pressing in the case of raisin grapes as in that of wine grapes, because the greater part of the raisin district is still uninfested by Phylloxera, it will sooner or later be of vital importance to the industry. For this reason a number of test plots have been started, with the coöperation of growers in various sections where raisins are produced.

In 1904 Muscat cuttings were bench grafted on the following resistant stocks:

Rupestris St. George.
Riparia Gloire de Montpellier.
Riparia × Rupestris 3309, 3306, 101^{14}.
Solonis × Riparia 1616.
Riparia × Berlandieri 33E, 34E, 157^{11}.
Rupestris × Berlandieri 301A.
Solonis × Cordifolia-Rupestris 202^{4}.
Aramon × Rupestris No. 1.
Mourvèdre × Rupestris 1202.
Lenoir.

Several hundred rooted bench grafts on St. George and 1202 were obtained and distributed to a number of growers in various districts, principally in Fresno County. Smaller quantities on the other stocks were obtained and distributed to a more limited number of growers.

Notes taken on the quality of the bench grafts before they were distributed were as follows:

Muscat on St. George. Heavy growth, complete unions but large swellings.
Muscat on 101^{4}. Good growth, complete unions, large swellings.
Muscat on 3306. Small growth, complete unions, small swellings.
Muscat on 1202. Heavy growth, complete unions, large swellings.
Muscat on Lenoir. Good growth, complete unions, small swellings.

Reports have been received from most of the growers who received vines, but they are of little value yet as showing relative vigor of the various stocks. One of the most complete reports is given below, by Dr. W. N. Sherman, Fresno:

Muscat on St. George. All grew vigorously.
Muscat on Riparia Gloire. All grew vigorously.
Muscat on 101[14]. Four out of six lived and made fair growth.
Muscat on 3306. Six out of ten lived and grew vigorously.
Muscat on 3309. All lived and grew vigorously.
Muscat on 1616. Six out of seven lived and grew vigorously.
Muscat on 33E. All lived, but made poor growth.
Muscat on 202[4]. Four out of six lived and made fair growth.
Muscat on 1202. All lived and made vigorous growth.
Muscat on Lenoir. Nine out of ten lived and made fair growth.

These vines were planted in overwet soil, and were all more or less injured by early autumn frost. Too much emphasis should not, therefore, be placed on the fact that some of them died.

The other reports show in general that the Muscats on St. George 3306 and Riparia Gloire on the whole made the best growth, while 101[14] and 33E generally made poor growth. The other stocks gave intermediate results. The results the first year are, however, apt to be misleading, even as regards vigor, for some stocks, for example. Berlandieri and its hybrids, are slow starting, but make a vigorous growth later. The question of crop can be determined of course only after several years of trial.

GENERAL RECOMMENDATION.

Only the pressing necessity of some rules to guide us in our immediate plantations will excuse the making of recommendations as to stocks in the present incomplete state of our knowledge of the behavior of the various stocks in the diverse conditions of our grape-growing regions. The present tendency to plant St. George in all soils and in all localities, however, is undoubtedly wrong, and has led to disappointment in many cases, and we already possess sufficient data to enable us to choose something better for many locations.

The Rupestris St. George has given its best results in the hot, dry interior on deep soils. It seems to be a particularly good stock for Tokay and Alicante Bouschet under such conditions. Its great vigor seems to promise a diminution of the tendency of the Tokay to sunburn. and the coulure which it produces with many varieties only extends to the production of loose bunches with the Tokay. This looseness of bunch is a distinct advantage with this variety. The coloring and ripening of the Tokay leave nothing to be desired when grafted on St. George.

For a great majority of our soils and varieties the two Riparia × Rupestris hybrids 3306 and 3309 promise to be superior in every way to the St. George. The former for the moister soils and the latter for the drier. The vigor and bearing of all varieties tested on these two stocks has so far been excellent, and they should in most cases replace St. George in all but the hottest and driest deep soils.

For the wettest locations in which vines are planted—in places where the water stands for many weeks during the winter, or where the bottom water rises too near the surface during the summer—the most promising stock is Solonis × Riparia 1616.

For moist, rich, deep, well-drained soils, especially in the coast counties and on northerly slopes, the St. George is utterly unsuited. The crops on this stock, in such locations, are apt to be small, and the sugar contents of the grapes defective. In these locations the Riparia Gloire is much to be preferred, and will undoubtedly give larger crops of better ripened grapes.

None of the above stocks give good results, as a rule, in very compact soils. For such soils the most promising varieties are 106^{8} in the drier, and Aramon × Rupestris No. 1 or 202^{4} in the wetter locations. In dry, shallow soils 420A and 157^{11} give promise of being excellent stocks.

This covers most of the soil conditions which occur in California. The only other cases which demand consideration are the varieties with defective affinity. For these varieties the most promising stock is 1202. This stock makes excellent unions with many varieties which fail on most resistants, and is to be tentatively recommended for Emperor, Ferrara, Cornichon, Muscat, Mataro, Folle blanche, Pinot, Gamay, Gutedel and any varieties which have not given generally satisfactory results on Riparia and Rupestris.

These recommendations may be summarized as follows:

For average, good soils in most locations—	
1. Drier soils	3309
2. Moister soils	3306
For special soils—	
3. Dry, deep, in hot regions and locations	St. George
4. Dry, deep, in cooler regions and locations	Rup. Martin
5. Dry, shallow	420A or 157^{11}
6. Dry and very compact	106^{8}
7. Wet and very compact	Aramon × Rup. No. 1 or 202^{4}
8. Wet, loose	1616
9. Rich, moist, deep, well drained in the cooler localities	Rip. Gloire
For varieties of defective affinity in good soils	1202

DESCRIPTION OF THE PRINCIPAL RESISTANT STOCKS.

In order to enable the grower to determine the correctness of the labeling of his resistant vines, the following brief description, adapted for the most part from "Les Vignes Americaines" of Prof. L. Ravax and accompanied by reproductions of original photographs, will be of assistance:

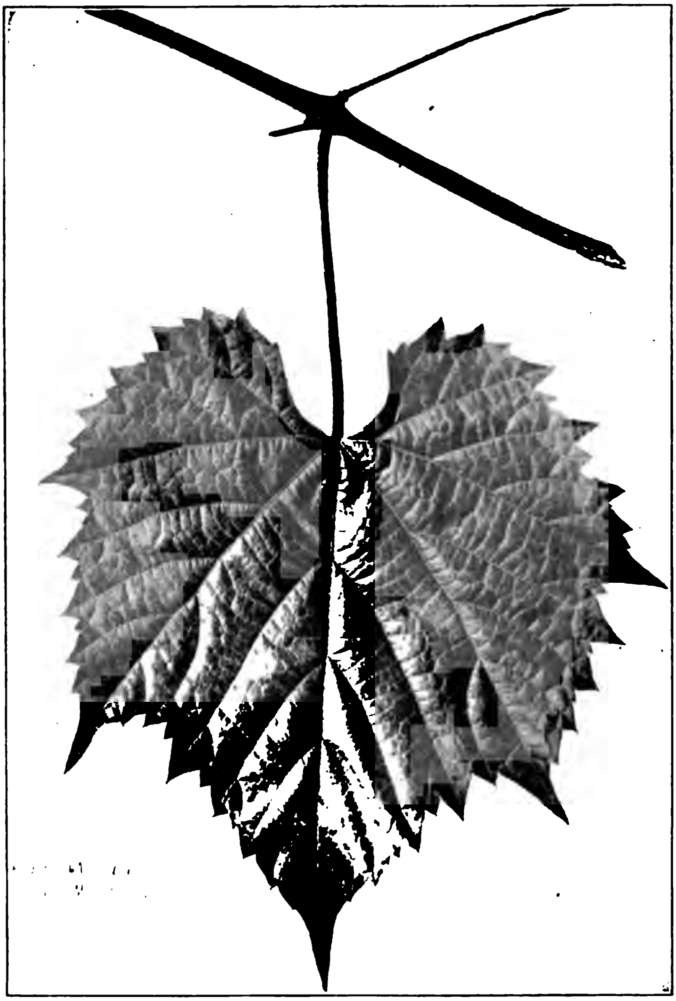

FIG. 1. Riparia Gloire de Montpellier. One third natural size.

Riparia Gloire de Montpellier (Fig. 1).—The most vigorous of all varieties of Riparia. Leaves *very large, as wide as long;* young leaves and tips pale green, canes and trunk thick. Male vine.

Roots well and grafts easily, either as cuttings or in the field. Trunk grows almost as large as the scion. Vines on this stock bear well, and the grapes are large, sweet and early.

Riparia Grande Glabre (Fig. 2).—Very vigorous, but does not grow so stout as the Riparia Gloire. Leaves large, longer than wide, with an almost *rectangular outline,* due to the short *terminal lobe* and the *straight sides.* Roots thin, hard and wiry. Fertile vine.

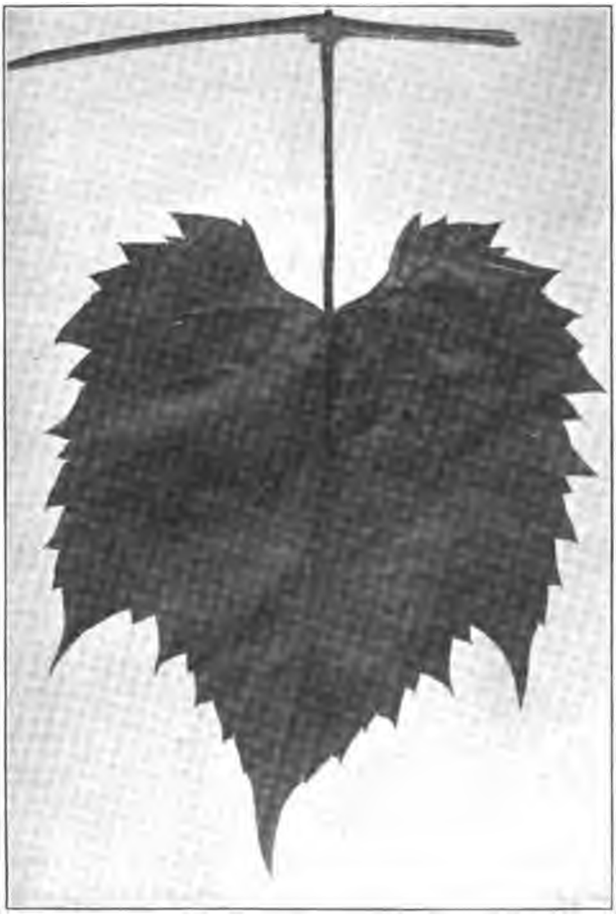

FIG. 2. Riparia Grande Glabre. One half natural size.

Roots well, but does not take the graft so well as Riparia Gloire. Almost equal to Riparia Gloire, but subject to "folletage." *Folletage,* or sudden dying of the vine, is a common fault of the unselected Riparias formerly grown in California, and for this and other reasons

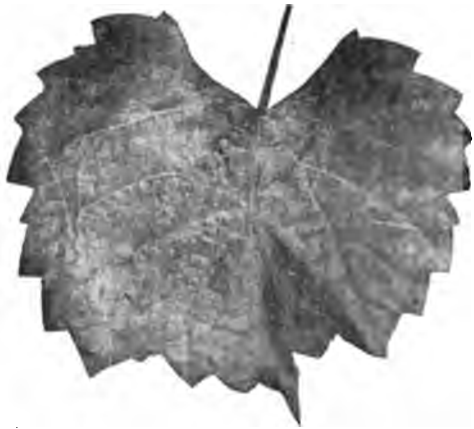

FIG. 3. Rupestris Martin. One half natural size.

the Riparia Gloire is to be preferred to the present or other varieties of this species.

Rupestris Martin (Fig. 3).—Very vigorous and one of the most robust of the existing stocks. Leaves larger than those of Rupestris St. George, and with a V-shaped petiolar sinus. Canes glabrous, pinkish, long and thick.

Roots easily, but is more difficult to graft than St. George. The grafts which grow are very satisfactory and are less liable to coulure than grafts on St. George. It succeeds in drier situations than the latter. Male vine.

Rupestris St. George (Fig. 4).—Perhaps the most vigorous of all the stocks grown when planted in suitable locations. Leaves small; the petiolar sinus very open, with a }-shaped outline. Canes and trunk very thick and robust.

This variety roots and grafts with great facility, and grows at least as large as any scion which is grafted on it. Succeeds in any soil except those underlaid with an impermeable or stiff clay subsoil.

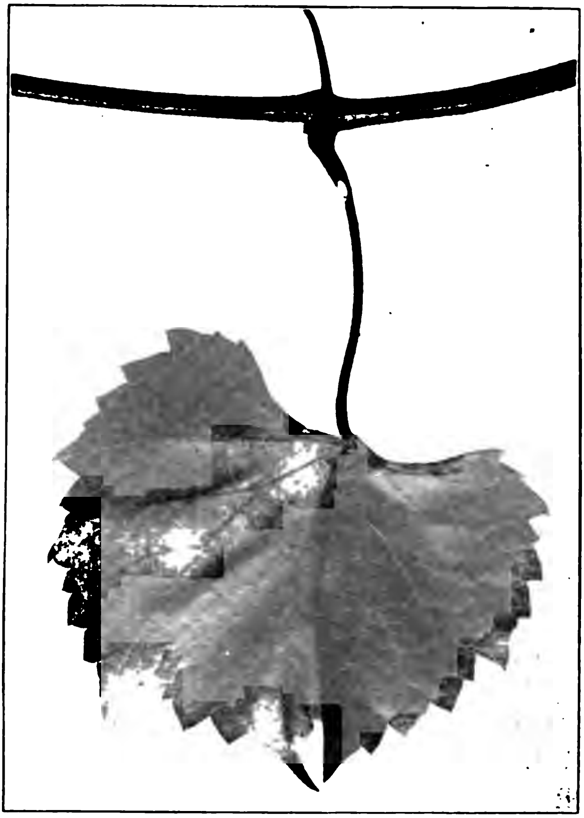

FIG. 4. Rupestris St. George. One half natural size.

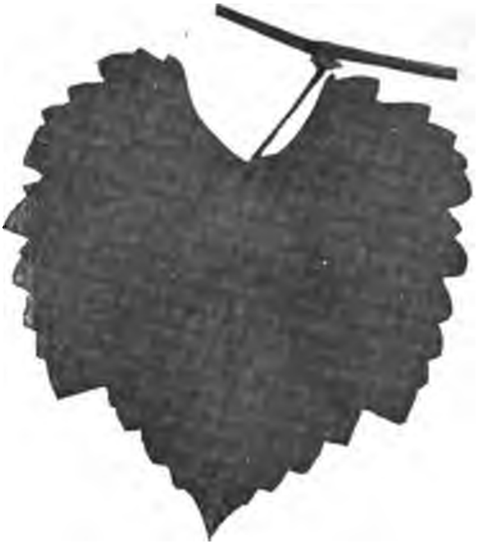

FIG. 4½. Rupestris Metallica of South Africa.

Rupestris Metallica (Fig. 4½).—The best varieties of Riparia and Rupestris give excellent results when they grow under appropriate soil and climatic conditions. Their range of adaptation, however, is comparatively small—that is, they are likely to give unsatisfactory results when planted in locations which differ in any considerable degree from those which suit them best. This seems to be due in great part to the direction their roots naturally take. Roots of Riparia are for the most part spreading and superficial, and succeed only where sufficient moisture exists near the surface. Roots of Rupestris are, on the contrary, plunging and deeply penetrating, and fail if an impenetrable subsoil prevents their taking their natural position.

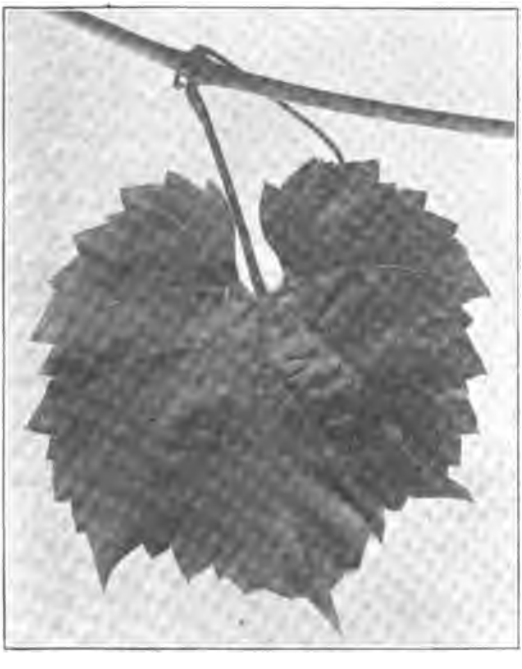

FIG. 5. Riparia × Rupestris 3309. One half natural size.

Experience has shown that crosses between Riparia and Rupestris have a much wider range of adaptation than either of their parents, owing to the fact that they are capable of forming a strong root system in both the upper and lower layers of the soil. Moreover, the best of them retain all the good qualities of both parents—high resistance to Phylloxera, ease of rooting and grafting, vigor and fruitfulness of grafts. The best of these hybrids, according to European experience, are those known by the numbers 3309, 3306 and 101^{14}. The first two are the most promising in California.

Riparia × *Rupestris 3309* (Fig. 5).—This variety resembles in habit a Rupestris, and the leaves are intermediate between those of the two parents.

It has small leaves, which, on the laterals, are rounded and without lobes. The young shoots and leaves are sparingly pubescent, but the rest of the vine is *glabrous,* and by this character readily distinguished from 3306. The vine is male, and therefore does not produce fruit.

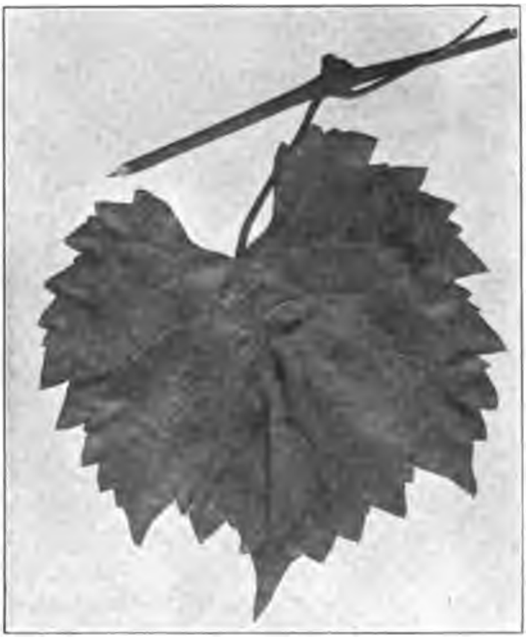

FIG. 6. Riparia × Rupestris 3306. One half natural size.

Riparia × *Rupestris 3306* (Fig. 6).—The general habit of this variety resembles also that of a Rupestris. but it is easily distinguished from 3309 by its *strongly pubescent* leaves and canes. Male vine.

Riparia × *Rupestris 101^{14}* (Fig. 7).—This variety resembles in habit its Riparia parent more than 3309 or 3306. Its range of adaptation is less than that of the latter, and it is most suited to fairly rich soils, such as those suitable to Riparia. It bears small bunches of small, round, black grapes.

Berlandieri Rességuier No. 1 (Fig. 8).—The pure Berlandieri varieties have all the qualities required in a stock—resistance to Phylloxera, ease of grafting, permanency of union, fertility of the scion, adaptation to varied soils—except one, that of ease of rooting. From 100 cuttings only 10 to 15 rooted vines are obtained by the usual methods of propagation. For this reason this species has never been used to any great extent. Certain crosses of this species with Riparia, however, while retaining the merits of the Berlandieri, possess rooting qualities almost equal to Riparia. They are particularly promising for shallow, stiff soils where the Riparia × Rupestris hybrids might suffer.

Riparia × Berlandieri 157^{11} (Fig. 9).—This variety was obtained by crossing a Berlandieri with pollen from Riparia Gloire de Montpellier. It has the habit and leaves of a Berlandieri, and a root system intermediate between those of its parents. It is thoroughly resistant to Phylloxera, and its grafts are vigorous, fruitful, ripen well, and are not subject to coulure. The cuttings root fairly well, and field grafts succeed very well. It produces an abundance of strong canes, but these do not ripen well in the cooler localities. It produces medium-sized bunches of round, black, pulpy grapes.

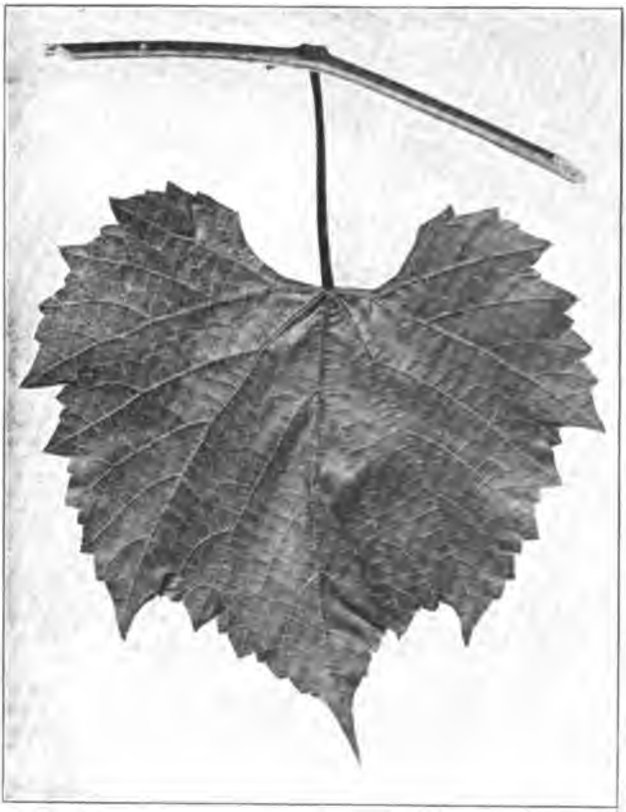

FIG. 7. Riparia × Rupestris 101^{14}. One half natural size.

Riparia × Berlandieri 420A (Fig. 10).—This variety is perhaps superior to 157^{11}. The cuttings root more easily, graft as well, and mature more regularly. It is more suited to bench grafting than the former, and makes vigorous and fruitful grafted vines. Male vine.

The Solonis is a hybrid of unknown parentage which resembles in its habits a Riparia. It was at one time much used as a stock, but its resistance to Phylloxera is insufficient. In California vines grafted on Solonis have been so weakened by Phylloxera as to be useless. Its only use is for wet, sandy soils, where it gives good results.

The good qualities of Solonis are found in certain of its crosses with Riparia, of which the most promising for California is 1616.

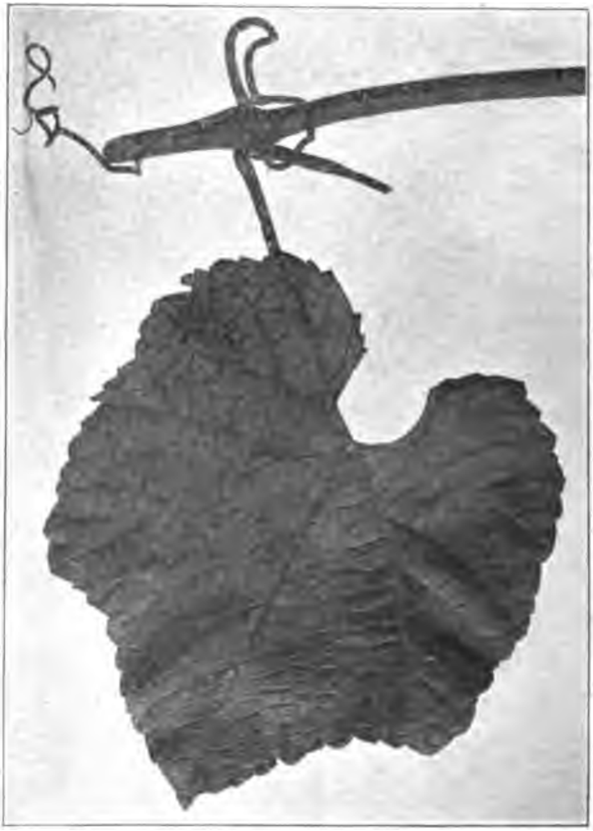

FIG. 8. Berlandieri Rességuier No. 1. One half natural size.

Solonis × Riparia 1616 (Fig. 11).—This variety is very vigorous, and the cuttings root and graft well. It is sufficiently resistant to Phylloxera, and is to be recommended for sandy and especially wet soils. Vine fertile, producing small, round, black grapes.

Riparia × Rupestris-Cordifolia 106^8 (Fig. 12).—This variety is vigorous and thoroughly resistant to Phylloxera. It is particularly recommended for stiff clay soils which become hard after rain and easily dry out. It is in just such soils that Rupestris St. George and

Riparia have often failed in California, and this variety therefore promises to be useful. Vines produce small, round, black grapes.

Solonis × Cordifolia-Rupestris 202[4] (Fig. 12½).—This variety is adapted to soils similar to those suited to 106[8], but resists humidity better. Prosper Gervais in his report to the Congrès International de Viticulture of 1900, at Paris, says: "The varieties 202[4] and 106[8] are especially suited to non-calcareous clay soils; the latter succeed in dry, poor, hot soils, providing they are not too shallow; the former in soils which are both compact and wet."

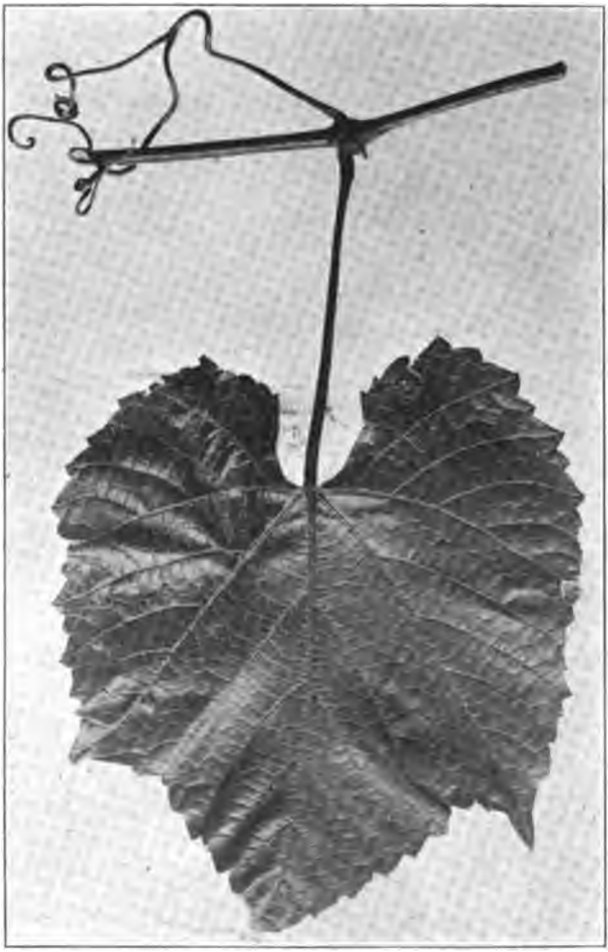

FIG. 9. Riparia × Berlandieri 157[11]. One half natural size.

Aramon × Rupestris No. 1 (Fig. 13).—This variety is the result of a cross between the vinifera variety Aramon and Rupestris Ganzin.

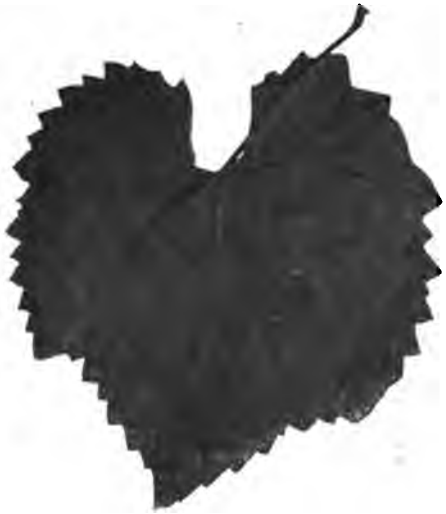

FIG. 10. Riparia × Berlandieri 420A. One half natural size.

The leaves resemble Rupestris, and unlike most crosses containing vinifera, its resistance to Phylloxera is quite sufficient and superior to that of Lenoir. It is very vigorous and roots easily from cuttings. It is somewhat difficult to graft, but when successful the grafts make good unions and are vigorous and fruitful. Its chief merit is that it succeeds in wet, compact soils, where most other varieties fail.

Mourvèdre × Rupestris 1202 (Fig. 14).—This variety is a cross between the Mourvèdre (Mataro) and a Rupestris. It is, perhaps, the most widely planted of all the American vinifera hybrids. Prosper Gervais describes it as "A stock characterized by its extreme vigor, rapid development, ease of rooting and grafting, and the fruitfulness of its grafts." It is particularly suited to deep, rich, humid, clay soils, and makes excellent unions with all varieties of vinifera.

The vine is fruitful, bearing large numbers of small, round. bluish-black

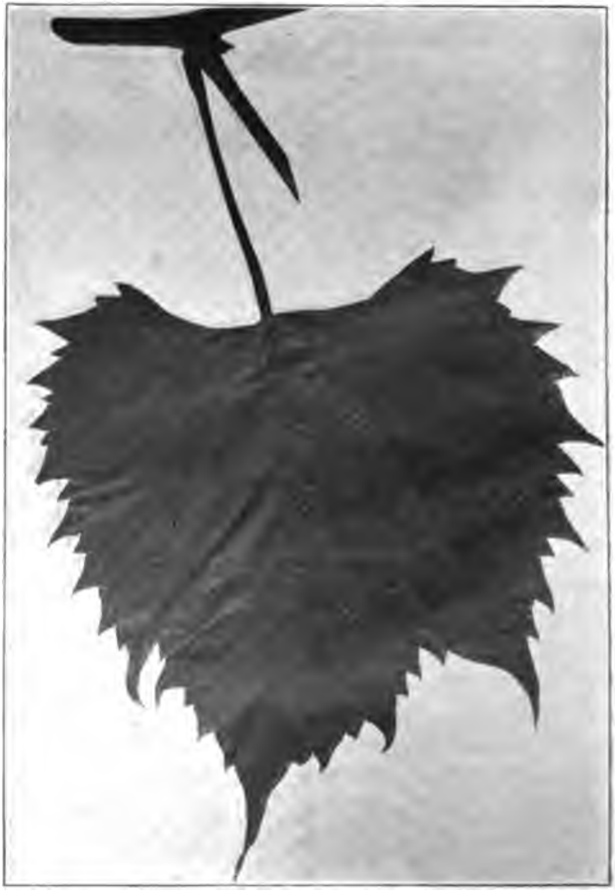

FIG. 11. Solonis × Riparia 1616. One half natural size.

grapes. It is grown extensively in France, Spain, Sicily, Portugal, and Roumania, and has given good results wherever tried. In California its vigor is remarkable, exceeding even that of Rupestris St. George.

OTHER VINE DISEASES.

Oidium.—The cause and treatment of this disease have been discussed in Bulletin 186, and the recommendations in it have been followed by a large number of growers this year in all parts of the State, usually with success.

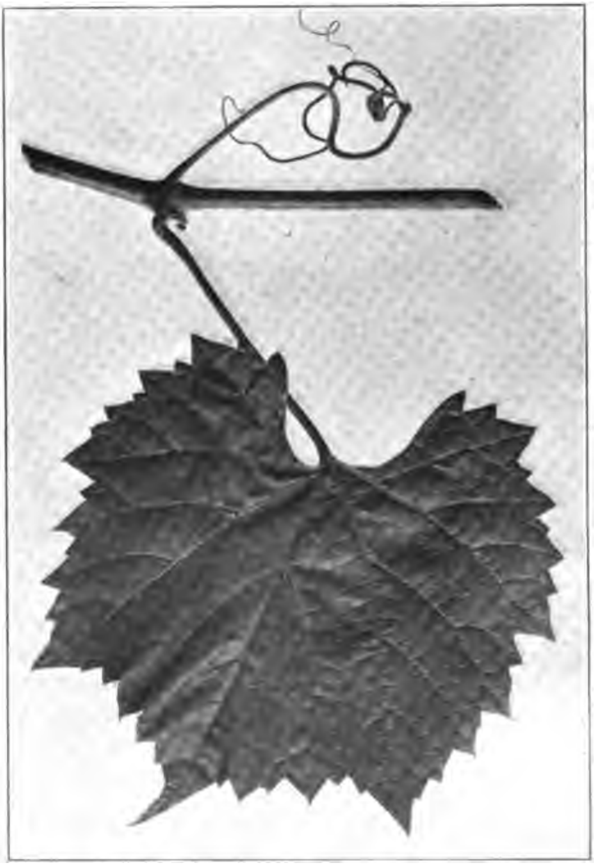

FIG. 12. Riparia × Rupestris-Cordifolia 106^8. One half natural size.

All of the reported failures which have been investigated have been due either to the incomplete carrying out of the recommendations, or to the fact that the vines were suffering from some other cause which had been mistaken for *Oidium.*

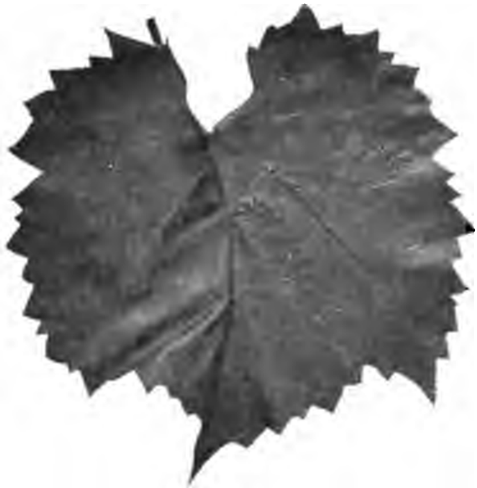

FIG 12½. Solonis × Cordifolia Rupestris 202^{4}.

The most common mistake of those who have attempted to follow the directions of the bulletin has been a failure to treat the vines thoroughly or rapidly enough in the beginning of the season. It can not be too strongly urged that the most effective way to control the mildew is by a thorough and effective sulfuring in the beginning of the season. This alone will in most parts of the State keep the vines free, and the sulfuring during the blossoming is needed only for its effect on the setting of the fruit, and as an extra precaution. Sulfuring later, if needed, is a proof that the first two have not been well done. This is true for the whole of the two central valleys and for most of California, except the coast belt subject to summer ocean fog.

Definition of a Thorough and Effective First Sulfuring.—The first sulfuring should be made when the shoots are between 6 and 15 inches long.. It should be done in such a way that *every part of every leaf of every vine in all parts of the vineyard* receives some sulfur, and the whole vine-

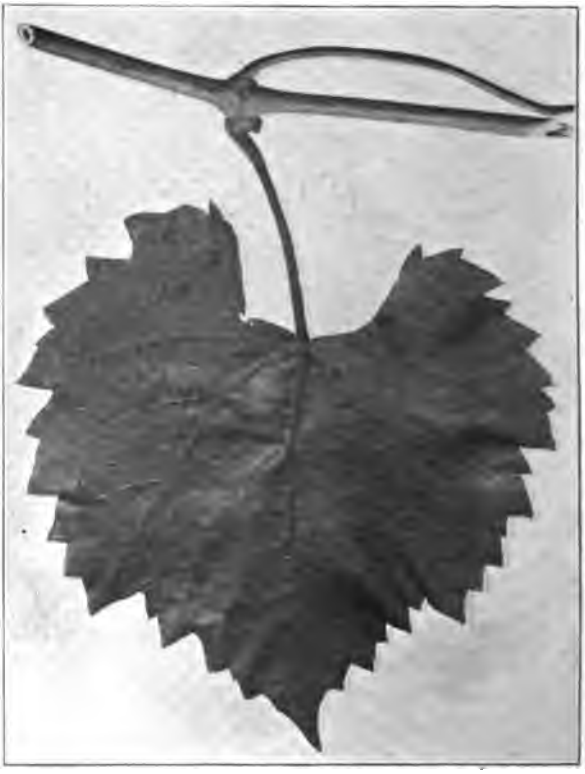

FIG. 13. Aramon × Rupestris No. 1. One half natural size.

yard should be gone over in as short a time as possible. This will be a *thorough sulfuring.* To be *effective,* it must be followed immediately by two or three days of warm weather. Unless this happens, the sulfuring should be repeated as many times as are necessary until the proper weather conditions are obtained.

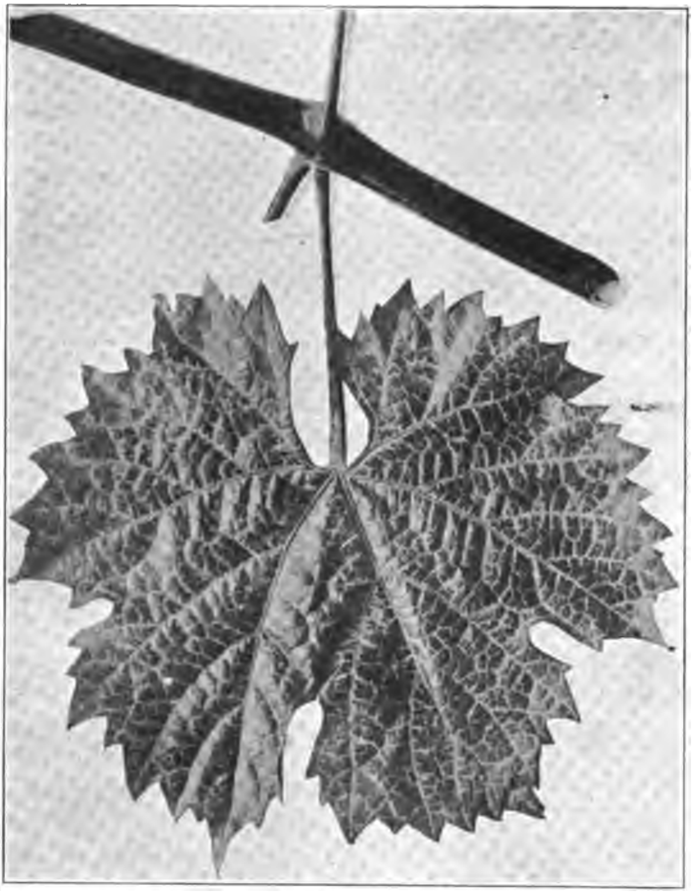

FIG. 14. Mourvèdre × Rupestris 1202. One half natural size.

Mysterious Dying of Vines ("Anaheim Disease").—The vine, like most plants, especially fruit trees, which are cultivated on a large scale, is subject to diseases of more or less intensity whose cause is not thoroughly understood. These diseases are (1) caused by parasitic organisms which have so far escaped detection, or (2) what is usually known as "physiological."

Physiological diseases are presumably due to some unfavorable conditions. For example, chlorosis, or the failure of the leaves to develop chlorophyll properly, is due to an excess of soluble lime carbonate in the soil, and is intensified by cold, dampness and the susceptibility of the variety.

The most serious of these two classes of diseases, which affects the vines, is the *Anaheim*, or, as it is sometimes called, the *California Vine Disease*. Notwithstanding that it has been the subject of continuous investigation for over fifteen years its cause is still quite obscure. Even the characterization and detection of the disease are so uncertain that vineyards, which after several years of observation by the most experienced investigators have been pronounced infected, have later been declared free. This has led to such a diversity of opinion that while one expert claims that the disease exists in every vineyard in the State, another would have us believe that no such disease exists at all, and that all cases of dying vines can be ascribed to one or other of the recognized vine diseases.

Neither of these extreme views seem to explain completely the observed facts. While many cases of supposed *Anaheim* have proved to be nothing but Phylloxera, root-rot, vine-hopper, drought, etc., there still remain a large number of unexplained cases.

In some cases the symptoms are practically identical with those of some of the "physiological" diseases which affect vine diseases in Europe. Typical cases of Rougeot have been noted in Contra Costa County, of *Brunissure* in San Joaquin, and of *Folletage* in Fresno, Kings, and other counties. In Sonoma County the disease of *Red-leaf*, which has some analogy with *Anaheim*, has been studied by Mr. O. Butler. An account of these diseases may be found in Bulletin 168, entitled "Observations on Some Vine Diseases in Sonoma County."

In a general way, as these troubles are due to soil and climatic conditions which weaken the vine, they are to be combated by cultural methods which tend to invigorate. Shorter pruning, thorough cultivation, irrigation or drainage, and fertilization will in most cases be effective in curing vines which are not too far gone.

Many cases have been brought to the attention of the station during the last two years, in which vines which were apparently healthy the previous year have failed to bud out in the spring, or budded out weakly and very late. The cause, in most cases, seemed to be some injury to the vines during the growing season of the previous year. This cause was in many cases the attacks of vine-hoppers. Black Prince vines growing in Tokay vineyards have very often been killed. This seems to be because the vine-hoppers, having a special fondness for this variety, congregate in large numbers on such isolated vines. Whenever the hoppers are sufficiently abundant to cause the dropping of the leaves in summer, the vine fails to ripen its wood properly.

Without mature green leaves the buds and canes do not receive the stores of starch which they need for the new growth in spring, and will either grow poorly the following year or fail to start at all.

When a new growth of leaves in autumn follows summer defoliation by hoppers, mildew, or other causes, the effect is even worse. The new shoots which start exhaust what food reserves the vine possesses, and the leaves are killed by the early winter frosts before they have been able to return the supplies they have taken from the canes. Similar, but less severe, effects have been observed following a bad attack of *Oidium*.

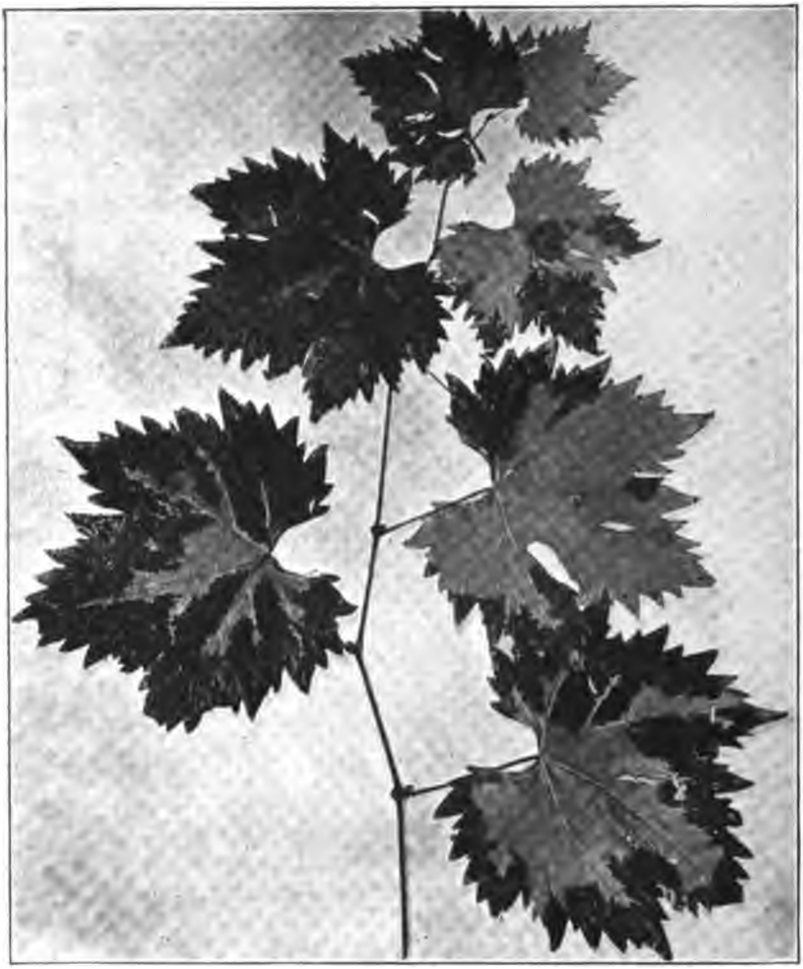

FIG. 15. Brunissure on Tokay leaves.

This starvation of the canes and buds may be brought about in another way, namely, by the production of too large a crop. It is often possible, by excessively long pruning, to cause a vine to produce an abnormally large crop of grapes. The larger the crop the more material it takes from the vine, and if too large, the vine is unable to support it and at the same time lay up reserve materials in its canes and buds. In consequence, an extra large crop is often followed by weak growth in the spring, and a consequent small crop the following autumn. Vines of heavy bearing varieties may even be killed in this way, by repeated long pruning.

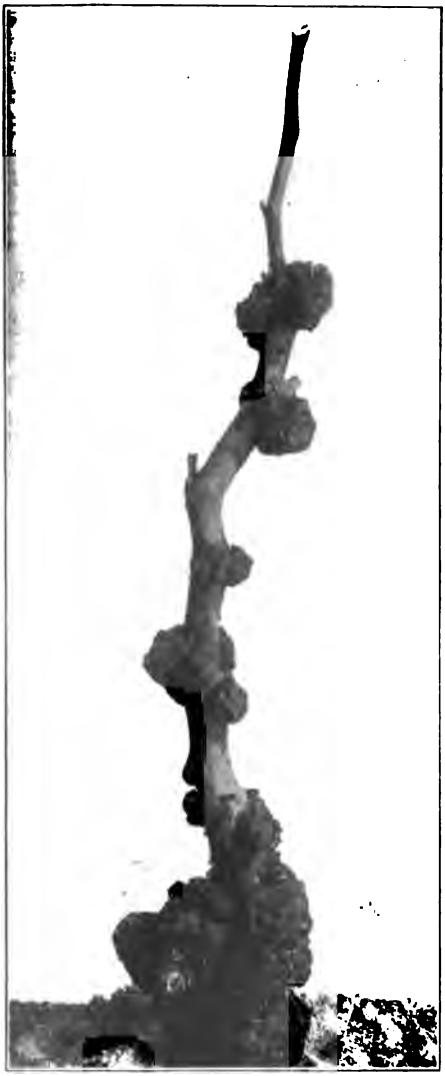

FIG. 16. Black Knot on 2-year-old Zinfandel.

This fact has been long recognized by practical grape-growers. Lately, Professor L. Ravaz,[1] of the National School of Agriculture at Montpellier, France, has advanced the opinion that the death of vines, as a consequence of overbearing, is much commoner than is usually supposed. This overbearing may occur as a consequence of various conditions other than long pruning. Some seasons are peculiarly favorable to heavy crops. Certain diseases and injuries induce temporary heavy bearing. Whatever the cause of abnormally heavy crops, Professor Ravaz believes that they may result in the death of vines. This is the explanation he gives of the death of large numbers of vines in southern France, Algeria, and other countries, and he ascribes our so-called *Anaheim* disease to the same cause.

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[1] "Influence de la Surproduction sur la Vegetation de la Vigne," by L. Ravaz, Coulet et fils, Montpellier, 1906.

This is substantially the explanation given of the dying of vines in Santa Clara, in Bulletin 134, which was published before the region was declared infested by *Anaheim* disease. Whether this explanation is sufficient is still doubtful, though it is rendered probable by the fact that healthy young vineyards are now growing in Santa Clara, on the same soil where vines have been killed by "*Anaheim* disease."

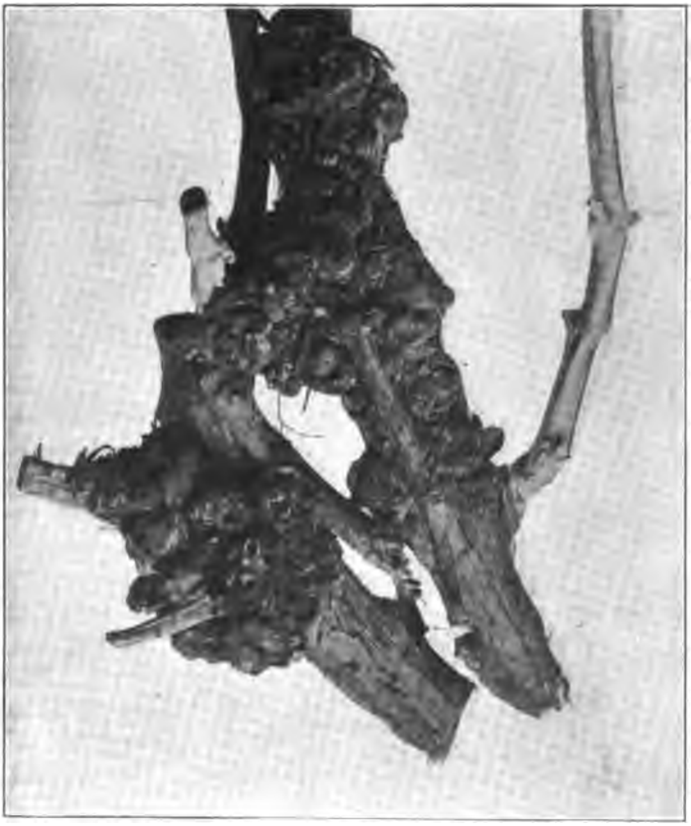

FIG. 17. Black Knot on arm of old vine.

Black Knot.—This is one of the commonest and most widely distributed diseases of the vine in California. Many specimens are received by the Experiment Station every year, from nearly all vine-growing sections. It consists of peculiar growths, or swellings, usually near the surface of the ground on the upper parts of the roots or the lower part of the trunk. It often occurs, also, on all parts of the trunk and branches, but only rarely on the canes.

As a rule it does little damage unless it occurs on young vines, or attacks old vines very severely. Figure 16 is the photograph of a young vine very badly attacked, showing a large mass of knots at the surface of the ground, and four on the stem above the surface. Such a vine is almost girdled and could never develop into a healthy plant. Figure 17 shows the appearance of the knot on a branch or arm. In this case the knots could be removed and the vine might recover perfectly.

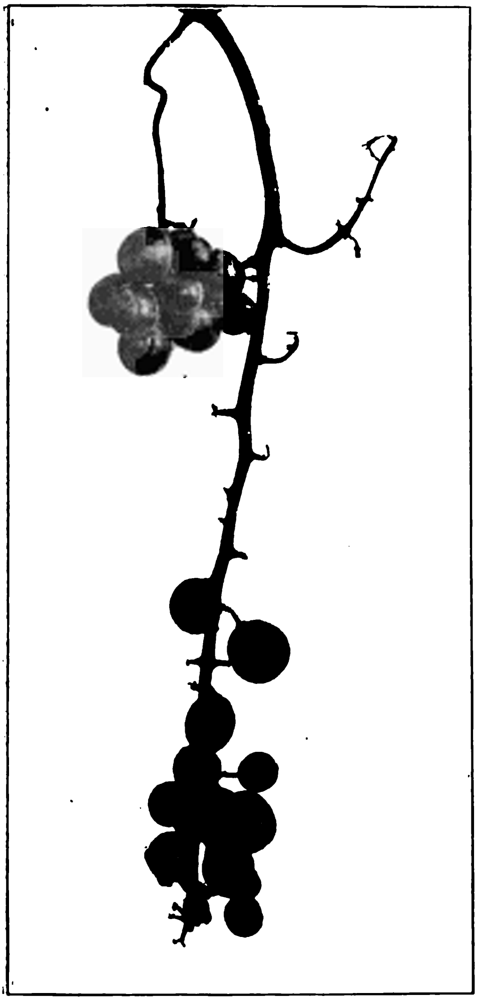

FIG. 18. Coulured bunch of Muscat of Alexandria.

It is not uncommon to find vines with large masses of knots on all sides of the trunk and on all the arms, which yet make a vigorous growth and produce good crops. When the knots extend all around the trunk of an old vine, however, it may be girdled, and, while it seldom dies, it may become weak and worthless.

Various theories have been advanced as to the cause of this disease, but the most commonly accepted is that it is due to abrupt changes of temperature, and especially to autumn frost occurring before the vine has become thoroughly dormant. This cause alone, however, does not seem to be sufficient to cause the disease. The knots appear only on vines growing in moist places, and especially in sandy soil in the hotter regions.

Anything which causes a vine to grow vigorously late in the season and prevents the proper ripening of the wood, renders it susceptible to the disease.

In accordance with these ideas, the remedies advocated aim at causing the vine to ripen its wood early and completely. These remedies are drainage of the soil, fertilization with phosphatic manures, longer pruning, raising the trunk of the vine, and removal of the knots.

Swabbing with lime, sulfate of iron, and other antiseptics has proven useless.

Coulure of Muscats.—The Muscat of Alexandria, from which the bulk of our raisins is made, has a tendency to drop its blossoms without setting. This trouble is usually known in California by the French term of "coulure," which may be translated "dropping." The first crop is particularly subject to this defect, which is often so serious that a large part and sometimes the whole of the first crop is lost.

The trouble has been investigated during the last twenty-five years by a large number of observers, and various causes assigned. Among these causes may be mentioned unfavorable weather, improper pruning, fungous attacks, unsuitable or exhausted soil. These causes and others may intensify the trouble, but the primary and essential cause has lately been demonstrated by P. Viala and P. Pacottet, and published in the "Revue de Viticulture."[1]

According to these investigations the cause of the dropping lies in the peculiar structure of the flower itself.

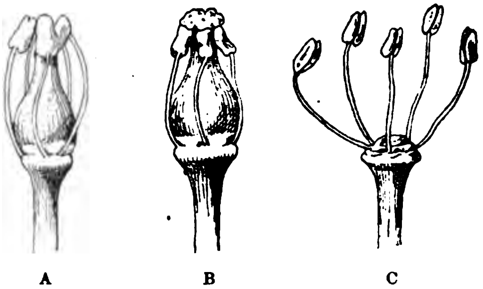

FIG. 19. (After Viala and Pacottet.)

A. Normal flower of the vine, with filaments as long as the pistil.
B. Defective flower of the vine, with filaments shorter than the pistil.
C. Defective flower of the vine, with abortive pistil.

The flowers of most cultivated varieties of grapes are what the botanist calls "perfect." That is, each flower has the two elements which are necessary for the development of the perfect fruit. These elements are the pollen contained in the anthers and the ovules contained in the pistil. Unless the ovules are fertilized by normal pollen the pistil will not develop into a normal grape berry.

There are several defects in the Muscat flower which make this necessary pollination more uncertain than with most varieties, and it is only under the most favorable conditions that the ovules are properly fertilized.

In the first place, owing to the shortness of the filaments supporting the anthers, the position of the pollen is such that it may all fall off without reaching the stigma, which is a part of the pistil through which the pollen tube obtains access to the ovule.

In the second place, the pollen is not powdery as with most vines, but waxy and with a tendency to cohere in masses. This renders its distribution by wind and insects much less certain. The pollen grains are, moreover, often imperfect, and most of them are incapable of germination and performing their function, even if they reach the stigma.

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[1] "Sur la Fécondation Artificielle de la Vigne," Revue de Viticulture, T. XXII, No. 551, pp. 5-10. Paris, 1904.

This is shown when we place the pollen grains in a weak sugar solution. Normal pollen germinates readily in such a solution, but that of Muscat of Alexandria germinates irregularly, imperfectly, or not at all. The same result occurs if the pollen is placed on the stigma of any variety of vine.

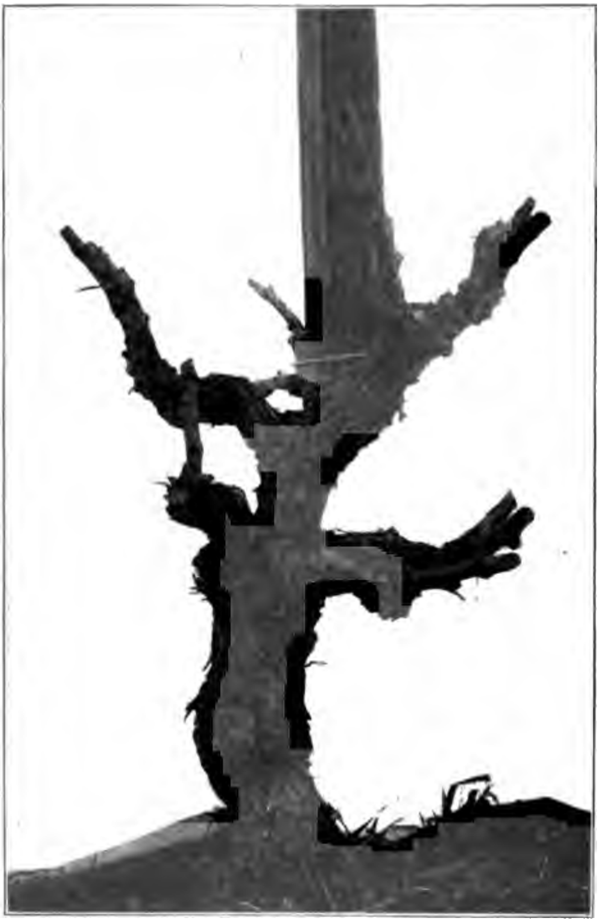

FIG. 20. Four-year old Muscat of proper form.

Remedies. — In regions where this variety has been grown for centuries (Asia Minor, northern Africa, Spain) it is usual to plant other varieties having abundant and strong pollen among the Muscat vines. This practice, while not removing the trouble completely, may be of use in California. It would be well in planting a Muscat vineyard to make use of some of the varieties which have shown their ability to produce abundant and vigorous pollen. The proof of this is regular setting of abundant crops. The pollinating varieties might be planted in neighboring blocks, or, better still, in occasional rows.

It is necessary not only that the pollinating varieties should have good pollen, but that they should blossom at the same time as the

Muscat. In accordance with the advice of Viala and Pacottet, the pollen of Aramon × Rupestris has been used with success in the hothouses of Paris for the artificial fecundation of Muscat flowers. This is a resistant stock which produces an abundance of blossoms which are completely staminate, and therefore incapable of producing fruit themselves. Their pollen, however, is extremely vigorous, and causes the fruit of other varieties to set well. The pollen of this variety is collected, dried, and, at the proper time, dusted on to the Muscat blossoms. As this variety blossoms about two weeks earlier than the Muscat, however, it could not be used for cross-pollination unless the pollen were collected and applied as described, which is of course impracticable in a vineyard.

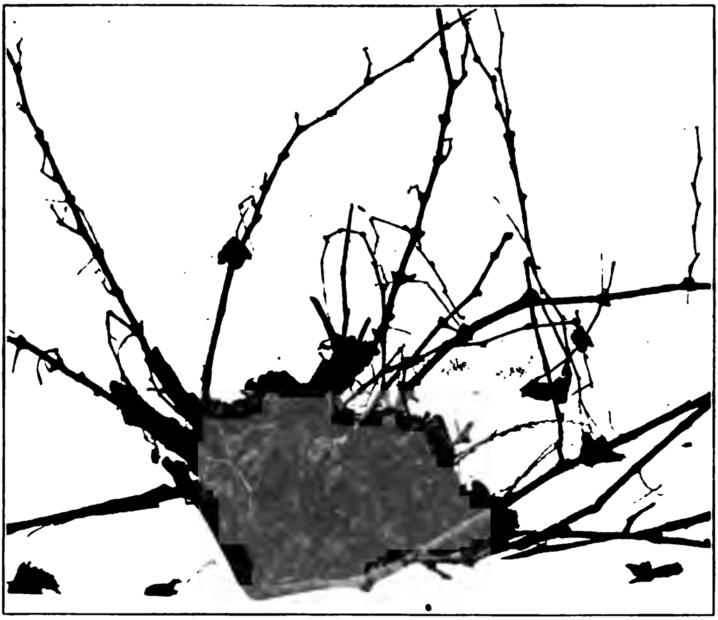

FIG. 21. Six-year-old Muscat of usual form.

Most of the varieties cultivated in the raisin districts blossom about the same time as the Muscat, and such varieties as Palomino, Perruno, Beba, and Burger, which always set their fruit well, would be suitable for the purpose.

Another peculiarity of the Muscat of Alexandria, noted by Viala and Pacottet, is that the stigma of the pistil is covered with a drop of liquid which forms and falls two or three times a day, thus removing pollen grains which may have reached the stigma. A moist atmosphere is, therefore, unfavorable to the setting of Muscat.

We can control the moisture conditions to some extent by avoiding cultivation or irrigation during and just before blossoming.

The air near the ground is moister than that a little higher up, and the practice of pruning Muscats to a low, prostrate stump is unfavorable for this and for other reasons.

A Muscat vine, like any other, should have a distinct stem or trunk. This trunk should be smooth and without spurs or scars. This trunk makes it possible to plow, cultivate, and hoe close to the vine without injuring the arms and spurs. It facilitates the removal of suckers from below the ground, and holds the bearing wood high enough up to keep the grapes from touching the ground. How high this trunk should be depends on various conditions. A smooth stem twelve inches in length from the surface of the ground to the branching of the arms is sufficient to give the advantage mentioned.

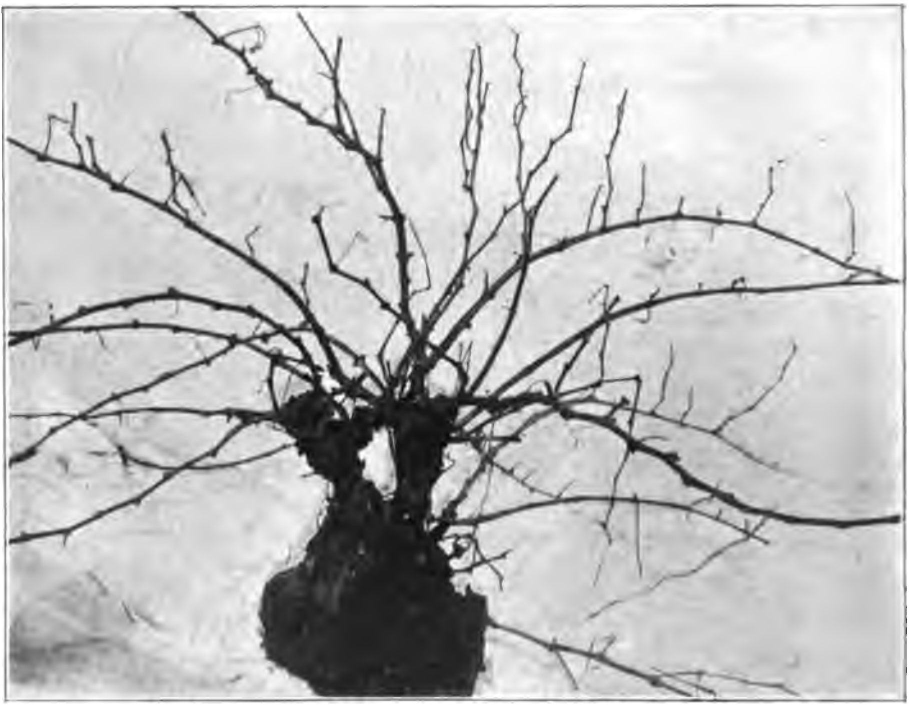

FIG. 22. Low Muscat raised by pruning.

IMPROVED METHODS OF WINE-MAKING.

By F. T. BIOLETTI.

The main work in enology has been directed to demonstrating and popularizing certain principles and methods of wine-making, which have been shown to be useful by the experiments of the California Experiment Station.

Cool Fermentation.—The greatly needed reform of the control of temperature in fermentation, which has been advocated by the station for many years, has at last been taken up extensively by the wine-makers of the State. It is no exaggeration to say that the general adoption of methods of insuring cool fermentation will result in doubling the value of our dry wines. Nothing deters the sale and expansion of the market for our fine wines so much as the production of bad wines in our hotter districts. Such wines spoil the reputation of all our wines. If all the dry wines made in California, even in the hottest and most unfavorable districts, were good, sound and wholesome, the market for the finer and higher priced wines grown on the slopes of the coast ranges would quickly expand.

No one change in our methods can have so much influence in this direction as the control of temperature of fermentation. The wines even of our most favorable regions can be improved by the same means.

The actual method of control, providing it is effective, is simply a question of economy. The first attempts of the wine-makers were by means which were both troublesome and inefficient. Efficient methods have been pointed out and demonstrated by the station. The most economical methods will soon be found by the wine-makers, now that they are convinced of the utility of the change.

Heat Extraction.—The new method of wine-making, described in Bulletin 177, has been given a fair trial and the results on the whole have been satisfactory. It has been demonstrated that a good, wholesome wine of remarkable keeping qualities can be made by this means. The color is deeper and more stable than that of wines made in the usual way and the control of temperature is much facilitated. In general, it gives greater certainty of obtaining a good and absolutely sound wine than the older methods. Whether the quality of the wine is equal to that of the best wine made by the older methods is still in doubt. It should be remembered, however, that this method is still new and imperfectly understood. Further tests are needed to demonstrate whether it is capable of producing wines of the highest quality.

The method has been taken up in practice in a limited way, and so far has given satisfaction.

The wines made in this way have shown a tendency to acquire a "port" taste, which is undesirable in dry wine. This taste, however, may be due to the character of the grapes used more than to the method. None of the red grapes grown in quantity in the San Joaquin Valley are suitable for the production of dry red wine in that region. Any grape which, like the Zinfandel, dries up into raisins on the vine, or easily acquires a "rancio" taste, like Mission or Grenache, is unsuited for the making of dry wine in a hot district.

Varieties for Dry Red Wine in the Interior Valleys.—Before the best results possible in the district are obtained, such grapes as Valdepeñas, Lagrain, St. Macaire, Gros Mansenc, Barbera, and Pagodebito, which have proved to retain their color, acidity and quality in the district, will have to be grown. All these varieties have given good results, both in quality and quantity, for years at the Tulare Experiment Station.

Pure Yeast.—Experiments with pure yeasts have been carried out by the station for many years. It is only within the last three years, however, that tests on a large scale have been undertaken. These tests abundantly demonstrate their utility in the hands of efficient winemakers.

They are particularly advantageous in the case of white wines. When used in connection with the preliminary defecation[1] of the must, remarkable improvements have been noted in the quality. If they had no other good effect, the completeness of the fermentation during the vintage, and the rapidity with which the wines become bright, bottle ripe and ready for consumption, are sufficient to justify their use.

Many yeasts have been tested by the station, but the best results, both for red and white wine, have been obtained by the use of one originating in Champagne.

This yeast is strong enough to ferment wines perfectly dry with over 15% of alcohol. It can withstand as high temperatures and as large an amount of sulfurous acid as any of our native yeasts which have been tested. One of its principal advantages is its tendency to form a concrete sediment, which remains at the bottom of the fermenting must or wine, and very much facilitates the racking and clearing. It has also been found equally suitable for champagne and cider-making.

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[1] See Circular 22.

Several wine-makers have used this yeast in their wineries, and it has given general satisfaction.

An idea of the benefits to be obtained by the use of a suitable pure yeast is given by a series of tests of the organisms existing on the grapes at the Tulare Experiment Station.

A large number of varieties of grapes were obtained at two different times from Tulare, and an investigation of the organisms existing on them and capable of growing in grape must was made. Although a large number of yeast and yeast-like organisms were isolated, not a single specimen of *Saccharomyces ellipsoideus,* the true wine yeast, was found. Many of the yeasts and pseudo-yeasts were tested by Mr. Hans C. Holm of the station, and all were found in various degrees useless or detrimental to the wine.

As there are no wineries in the vicinity of the Tulare Experiment Station, this is of course an extreme case. In all grapes examined, however, from all sources, the true wine yeast was always found in a very small minority, and accompanied by other organisms which, if allowed to develop, would undoubtedly affect the wine unfavorably.

The best way of avoiding these unfavorable effects is by the use of a starter of pure yeast, preceded, in the case of white wine, with a thorough defecation of the must.

If this measure is properly carried out and accompanied by methods of manipulation which will ensure a pure and thorough fermentation, no trouble will be experienced with "stuck tanks," high volatile acid, "mousey tastes," permanently cloudy wines, or any of the numerous troublesome and costly defects which afflict so many of our wines made in the old, haphazard way.

The utility of pure yeast in our Californian wineries may be considered as demonstrated, but too much must not be expected of it. It will not prevent the ill effects of careless or ignorant practice, and no wine-maker who can not make good wine without pure yeast will succeed with it. For the careful and intelligent wine-maker, it will be a great aid in the improvement of his wines, and in the added certainty of good results. To the careless or unskillful, it may even be a source of danger by accelerating his fermentations and thus increasing the temperature.

Those who wish to test pure yeast are advised to commence with a certified culture from the station, to follow the directions of Circular 23 carefully, and to commence at first only with white wine. With white wine the good effects of pure yeast are more striking, and the possibility of too strongly accelerating the fermentation less to be feared.

COLOR GRAPES.

In many parts of the State the amount of color in the grapes is insufficient for the quantity of red wine which it is desired to make.

The station has, therefore, given considerable attention to the testing of the color capabilities of various varieties in different sections, and to the devising of methods of utilizing economically the color which exists in the grapes now grown.

A variety which has abundant color in one locality may have almost none in another. Carignane, Grenache, Mourastel, Aramon, which usually contain sufficient color in the coast counties, can be used only for white wine in the hotter parts of the central valleys unless blended with color grapes.

The color of all varieties is less in quantity and less stable in character in the warmer climates and richer soils. A careful choice of varieties in this respect is, therefore, necessary in the central valleys. The following table, compiled from a large number of tests, illustrates this point:

Colors of Grapes in Cool and in Hot Localities.

Variety.	Cool Localities.		Hot Localities.	
	At Pressing.	At 4 to 6 Months.	At Pressing.	At 4 to 6 Months.
St. Macaire	2 1VR 189	2VR 66	VR 138	2VR 30
Gros Mansenc	6 2VR 119	3VR 61	3VR 64	4VR 24
Gamai Teinturier	7 2VR 96	3VR 38	5VR 36	5VR 11
Barbera	9 1VR 88	3VR 28	1VR 69	5VR 20
Refosco	8 1VR 93	4VR 29	1VR 54	5VR 17
Petite Sirah	4 VR 133	3VR 48	3VR 44	Y 13
Petit Bouschet	1 VR 239	1VR 74	3VR 49	2R 15
Alicante Bouschet	3 1VR 151	1VR 53	4VR 40	4R 13
Valdepeñas	5 1VR 129		1VR 35	2R 12
Pagodebito			VR 49	
Alicante Ganzin	VR 667			
Lagrain			1VR 63	

This indicates that for the San Joaquin Valley the best grapes for color, of those commonly grown in the State, are St. Macaire, Gros Mansenc, and Barbera, in the order named. Wines made from these varieties at Tulare and Fresno have from half again as much to three times as much color as the Bouschets, and the tint is better and more stable. In aging, the other varieties, such as the Bouschet and Sirah, retain barely enough color for a standard wine, and the tint becomes very yellow. None but the three varieties mentioned, together with the Refosco, have always kept enough to allow them to be mixed with varieties lacking in color.

Besides color, these three varieties retain high acidity and a freshness which make them very valuable in this district for dry red wine.

The color of a wine depends not only on the character of the grape from which it is made, but also on the process of manufacture. The utility of sulfur fumes and sulfites in dissolving and keeping the color has already been pointed out in Bulletin 177. It has also been shown in the same publication that the heat-extraction method also results in deeper and better color than the ordinary method of fermentation. This is exemplified further by some tests made on grapes grown at the Tulare Experiment Station.

These grapes were received on September 17, 1907, and each variety divided into two equal lots. One was fermented in the ordinary way, and the other was heated to 65°C. for three hours, and the juice after pressing out fermented without the skins. The results are shown in the following table:

Extraction of Color by Heat and by Fermentation.

VARIETY.	COMPOSITION.		HEATED MUST.		Fermented on Skins.
	Solid Contents.	Acid.	Before Fermentation.	After Fermentation.	
Lagrain	25.0	.60	VR 190	2VR 89	1VR 63
Pagodebito	22.0	.67	VR 148	1VR 74	VR 49
St. Macaire	25.0	.83	VR 148	1VR 52	2VR 41
Alicante Bouschet	20.7	.71	1VR 118	2VR 56	3VR 44
Gros Mansenc	24.0	.83	VR 105	1VR 55	1VR 41
Valdepeñas	23.0	.52	VR 80	VR 33	1VR 26
Beclan	22.0	.45	VR 78	1VR 30	2VR 17
Mean	----------	----------	VR 124	1VR 56	2VR 40

VARIETY.		COLOR REMAINING AT			
		1 Month.		10 Months.	
		Heat Extraction.	Ordinary Fermentation.	Heat Extraction.	Ordinary Fermentation.
Lagrain	----------	2VR 89	2VR 44	4VR 47	R 16
Pagodebito	----------	2VR 63	1VR 36	5VR 38	3R 24
St. Macaire	----------	5VR 48	1VR 43	----------	3VR 20
Alicante Bouschet	----------	3VR 49	1VR 46	4VR 34	4VR 20
Gros Mansenc	----------	3VR 50	1VR 48	3VR 15	3VR 23
Valdepeñas	----------	2VR 37	1VR 24	2VR 27	5VR 16
Beclan	----------	3VR 29	4VR 16	5VR 12	2R 10
Mean	----------	3VR 42	2VR 39	3VR 39	5VR 18

Summary of Results in Table.

		After Fermentation.	After 1 Month.	After 10 Months.
A. Heated must	VR 124	----------	----------	----------
B. Fermented must		1VR 56	3VR 42	3VR 39
C. Ordinary fermentation		2VR 40	2VR 39	5VR 18

These tests illustrate the beneficial effect of heat extraction on the amount and the permanency of the color. This is shown in table, where A represents the total average amount of color extracted by heat. This may be taken to indicate the total amount of color contained in the grapes. Of this amount 45% remained in the wine immediately after fermentation, while only 32% was extracted by the ordinary process of fermentation.

At the end of ten months the wines made by heat extraction had lost 48% of their color, and those made by the ordinary method, 55%. At ten months, therefore, the wines made by heat extraction had on the average 61% more color than those made by the ordinary method (see B, C in table), and the quality of the color, 3VR, instead of 5VR, was also superior. These results corroborate those reported on page 28 of Bulletin 177, where experiments made on a large scale under the conditions of an ordinary winery showed a gain of 42% at four and one half months in favor of heat extraction. The gain appears to be the greater the older the wine, showing superior stability of the color when extracted by heat.

The need of more color in the wines of many districts has led to the planting of a considerable area of Lenoir vineyards. The Lenoir is an unsatisfactory grape for this purpose, however. The color is unstable and quickly becomes yellowish. The color, even at first, is little if at all deeper than that of several vinifera varieties, and if any considerable proportion of the grapes are used they very much diminish the quality of the wine.

A recently imported grape, the Alicante Ganzin, gives promise of being much superior for this purpose. This vine is the product of a cross between Alicante-Bouschet and Aramon-Rupestris, and is, therefore, three fourths vinifera. Its resistance to Phylloxera is about equal to that of Lenoir, and it can, therefore, be safely planted without grafting only in the rich, deep soils where Lenoir resists.

The wine is better than that of Lenoir and almost without foxy or other undesirable flavor. Its value consists in the great intensity of its color. A sample of the grapes grown by Mr. F. T. Swett of Martinez was received at the laboratory and tested for color, with the following results:

Color of Alicante Ganzin.

A.	Heated to 90°; color of must	VR — 800
	A, after fermentation, color of wine	VR — 667
B.	Fermented on skins; color of wine	VR — 667

The color is thus shown to be of the best tint, and more than twenty times as intense as a good Zinfandel, or twice as intense as the darkest Bouschet.

In order to test the color remaining in the pressed pomace it was mixed with white must, and fermented, with the following results:

C. 1 part pomace from A + 4 parts white must + .4% citric acid.
Color of wine ....2VR — 66.
D. 1 part pomace from B + 4 parts white must + .4% citric acid.
Color of wine ....2VR — 67

This shows that all the color remaining in the pressed pomace can be extracted and utilized by refermenting with white of lightly colored grapes. The wines after fermentation were kept in bottles, and three weeks later showed the following amounts of color:

A.	VR 441	loss 33%
B.	VR 364	loss 45%
C.	2VR 56	loss 15%
D.	2VR 57	loss 15%

This indicates the superior stability of the color extracted by heat (A) over that extracted by the usual method of fermentation (B). It also shows that blending should be done as soon as possible, preferably in the fermenting vat, in order to preserve as much as possible of the color.

The color of this wine when undiluted is so deep that it can be used for writing. It may be useful for coloring jellies in place of the various coloring matters often used. One ton of Alicante Ganzin fermented with twenty-five tons of white grapes would give a red wine of standard intensity of color. If fermented with red grapes, which were too light, but still had some color, one ton would be sufficient to bring fifty to seventy-five tons up to the standard.

GRAPES FOR DRY WINE IN THE SAN JOAQUIN VALLEY.

In a general way it may be said that the varieties, red more especially, which have given good results in the coast regions fail to produce good dry wines in the hot interior. They are usually deficient in acidity and color, many produce wines of flat and insipid character, and a large number acquire a "port" taste which is undesirable in dry wine. Certain varieties which yield a fair dry wine in the cooler regions can be used successfully for port in the hotter. Examples of this are Zinfandel, Alicante Bouschet, Charbono, and Carignane. Varieties such as Grenache, Mataro, Mission, Trousseau, Chauché Noir, and California Black Malvoisie do not produce a good dry wine anywhere. This includes practically all the red wine grapes which are grown to any considerable extent in the San Joaquin and Sacramento valleys. In the central and cooler parts of this region the Zinfandel, Carignane, and Alicante Bouschet give good crops of passable quality. In the hotter parts their wine is very defective.

Nearly all of these varieties, however, could be used successfully if they could be blended in the fermenting vat, or soon after, with 25% to 50% of other varieties, which have the characteristic which they lack.

The main defects of the wine of the varieties at present grown in the interior are low acidity, insufficient and unstable color, a tendency to oxidation (rancio taste), and a lack of that indefinable quality known as "freshness." The Zinfandel, especially the second crop, when picked in prime condition, is perhaps the best of all the varieties at present grown in the interior. It is, however, too subject to drying up and black mold to be relied upon as a dry wine grape. The peculiar flavor of the Zinfandel, moreover, becomes too intense in the hotter regions.

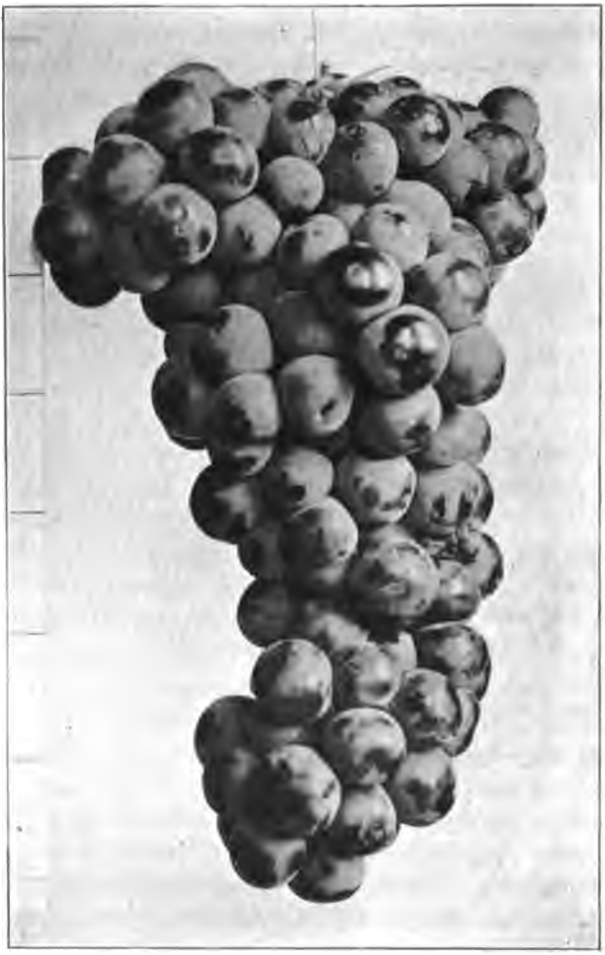

FIG. 23. Valdepeñas. Five eighths real diameter. Bunch one fourth natural size.

Of all the varieties which the station has tested in the interior valleys, that which combines the largest number of good points as a dry wine grape is the Valdepeñas. This variety, originating in Spain, is unsatisfactory in cool regions. In Napa and Sonoma its bearing is insufficient, and the wine is harsh and without high quality. These qualities, even there, are modified and improved by grafting on resistant stock, especially on Riparia, and in the hotter parts of the interior they disappear completely.

The Valdepeñas at Tulare has produced regularly large crops of fine, clean grapes with short pruning. It is not subject to sunburn or black mold, and the grapes will stay on the vines, without injury, as long as those of any variety. The wine made from it has always been satisfactory, showing color, acidity, and freshness almost equal to wines made in the coast counties. If only one variety were to be planted for dry red wine in the upper San Joaquin Valley, this undoubtedly would be the best of any that have been tried.

What is needed, however, perhaps more than a variety which will make a good wine itself in this district, is one which by blending can be used to correct the deficiencies and defects of the varieties already growing there. Varieties which will bear good crops of grapes with full acid and color would be of great service to the wine-makers of the interior, and enable them to bring up the quality to the Zinfandel, Carignane, and Bouschet sufficiently to make a good, sound, bulk, dry wine.

The experience at the Tulare Experiment Station, where a large number of varieties have been grown for twenty years, enables us to recommend certain good bearing varieties for this purpose. Those which have given the best results are:

Valdepeñas	quality
Lagrain	color and quality
St. Macaire	color and acidity
Gros Mansenc	color and acidity
Barbera	color and acidity
Pagadebito	color and acidity

Varieties for Dry White Wine in the Interior Valleys.—Dry white wines of fair quality can be made in the hot interior districts more easily than red. They have some of the same defects as the red, viz., lack of acidity, flavor, and freshness. By proper choice of varieties, and careful methods of manufacture, however, marketable white wines can be made with some of the varieties now growing there.

The Burger is peculiarly suited to these regions. It yields a neutral, clean tasting wine, which only requires blending with a full flavored wine from the coast regions to be worthy of aging and bottling. This was abundantly demonstrated by the experiments detailed in Bulletin 177. Burger wine, made in experiment VIII, developed into a surprisingly clean tasting, agreeable wine. The Burger retains its acidity better than most varieties at Tulare, but still requires blending with coast-county wines or the addition of citric acid. The white varieties which have developed the highest acidity have been West's White Prolific and Vernaccia Sarda.

The Johannisberger and Franken Riesling have given unexpectedly good results in the San Joaquin Valley. The wines of experiments

VI and VIa of Bulletin 177 have developed into wines showing flavor and bouquet that almost entitle them to be classed as fine wines. They have, however, a certain heaviness that should be corrected by judicious blending.

That the Rieslings, which produce the finest wines of the Rhine, should succeed under the totally different conditions of the San Joaquin Valley, shows that the origin of a variety is not always a safe guide as to its adaptability. The Sercial, from which the fine dry wines of the Island of Madeira are made, is said to be identical with the White Riesling used in the manufacture of the famous wines of Schloss Johannisberg.

A STUDY OF YEASTS FROM CALIFORNIA GRAPES.[1]

BY HANS C. HOLM.

The varieties of Saccharomycetes and Pseudo-yeasts, described in the following pages, were obtained originally from California grapes, of which some were sent from the Experiment Station at Tulare, and others were purchased at the local market in Berkeley.

The line of experiments was carried out with the intention of determining the amount of alcohol which the various yeasts were able to form in a sugar solution, and whether the yeasts on California grapes mainly consisted of types which might be depended on in wine-making. The fermentations were not restricted to must alone, but artificial media were made up in order to study the action of the yeasts on various sugars, that is, on dextrose and on saccharose. The so-called Laurent solution (see below) was used, and the specific sugar added. Comparative tests of fermentation carried out in grape-must, saccharose and dextrose solutions were made, and the results will be found below (see table).

The yeasts were all used in pure cultures only; the pure cultures were made by Koch's plate-culture methods, and in all cases not less than two sequent series of plate-cultures were made in order to eliminate the chance of impurity—that is, the presence of more than one species in the culture—to the least possible figure. The gelatine used in these experiments was a gelatine made up of must (10% Balling), 14% gelatine and .05% phosphate of potassium. It was found that a percentage of gelatine less than 14% would be impracticable, as the gelatine hardens with difficulty in the hot summers of California, and a liquefaction of gelatine in the plate-cultures would of course make the experiment uncertain, if not entirely unreliable:

Laurent's Solution.

Ammonium sulphate	4.71 grms. per liter
Potassium phosphate	0.75 grms. per liter
Magnesium sulphate	0.10 grms. per liter

To this solution any sugar may be added in the desired quantity.

The yeasts examined have been numbered for the sake of reference, and pure cultures of these varieties are left in the pure-yeast collection belonging to the Department of Viticulture, University of California.

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[1] Written as a Thesis for the degree of B.S.

It was the experimenter's idea that the amount of carbonic acid gas formed during fermentation might give some comparative results if collected in fermentation tubes, and that in this way it might be possible to eliminate all those yeasts which do not ferment sugar at all, and also to classify the varieties of yeasts as "high" and "low" fermenting yeasts. The result was a rather negative one, it being found that most of the varieties were strictly obligate-aërobic, and that they under no conditions could be brought to form any carbonic acid gas (or other gas) in the closed end of the fermentation tube. The further details of these experiments are stated on the following pages.

SACCHAROMYCES ELLIPSOIDEUS BIOLETTI I.

(This variety has been named after Assistant Professor F. T. Bioletti, Department of Viticulture, University of California.)

The yeast was isolated from grapes purchased on the local market in Berkeley. The form of the yeast as seen under the microscope is elliptical.

A 10% water solution of cane sugar in a fermentation tube was inoculated and placed in the incubator at 25°C. After four days the solution was examined. Neither film formation nor gas was noticed. In order to determine whether this inactivity was due to lack of nutritive contents a parallel experiment was carried out, with a Laurent solution containing 1% of cane sugar. After being placed for four days in the incubator at temperatures between 22°C. and 25°C. the result may be stated as follows: No growth, no gas, no film, and but a slight turbidity, indicating the growth of the yeast, but apparently without gas formation.

A fermentation tube containing 10% must was next inoculated with Sacch. Ellip. B. I, and placed in the incubator at 25°C. After twenty-four hours no gas or turbidity was noticed, but on the following day gas formation began, and gradually a large amount was formed in the closed tube. The gas was tested with a 5% KOH solution, and found to be carbonic acid. The gas formation now became so rapid that it was evident that a 10% must was much too concentrated, and for matter of comparison with results from other yeasts would have to be replaced by a 1% solution. However, the experiment with the use of fermentation tubes was not carried any further on this yeast, because the experiments on the other varieties showed the fermentation tubes to be unsuited to comparative tests.

A series of experiments was now carried out on Sacch. Ellip. B. I, as well as on all the other yeasts isolated from Californian grapes. Ordinary must, as well as Laurent's solutions, were inoculated with the various yeasts, and the alcohol formed was determined by distillation.

The specific gravity was taken by means of a picnometer, and Windish's tables (Berlin, 1893) were referred to. For the determination of extract the specific gravity was taken, and the corresponding per cent of extract was found from the tables.

A must containing 21.67% Balling was inoculated with Sacch. Ellip. B. I, and the fermentation was carried through at an average temperature of 24°C. The yeast settled well, and the liquid remained clear without any film formation, and a high aroma was noticed. After eighteen days the fermentation was at a standstill, and an analysis showed the amount of alcohol to be 10.61%, leaving 2.69% of extract in the fermented liquid.

The same yeast was next inoculated in a Laurent solution to which saccharose had been added until the solution showed a 19.68% Balling. After the fermentation had ceased, that is, after eighteen days at a temperature of about 25°C., the alcohol was found to be 2.09% by volume, leaving 12.19% Balling in the liquid after fermentation. The yeast had settled well and no film formation was noticed.

A Laurent solution made up with the addition of dextrose was next inoculated, and after eighteen days at 23°C. the alcohol was found to be 3.49 by volume. The extract in the dealcoholized must was found to be 5.87% Balling. The yeast had settled well, leaving the liquid bright, and a high aroma was noticed.

These results show that the yeast has a very slight inverting power, because the cane sugar remained practically unfermented. The results also tend to show that the Laurent solution is a rather unsatisfactory medium, as far as yeast is concerned; and the results derived from fermentations with other yeasts only verify this conclusion. The importance of the chemical composition of the medium is clearly illustrated in the results from the three experiments, carried out respectively with must, cane sugar solution, and dextrose solution, the two latter sugars being dissolved in Laurent solution. The yeast grows best in its natural medium, and the application of an artificial solution, as that of Laurent, can only be recommended in special cases where the activity of the yeast on a specific kind of sugar is to be determined. It is here of special importance that the liquid does not contain even traces of acid, as an acid solution would gradually of itself act on the sugar and change the saccharose into invert-sugar.

YEAST 26. FROM BURGER GRAPES.

This yeast was obtained from "Burger" grapes from Tulare. The crushed grapes were placed in the incubator for four days at a temperature of 30°C. Dilution cultures were made, and the plates showed besides the omnipresent *Apiculatus* yeast, another yeast resembling a

Mycoderma in shape and size. A pure culture was made of this variety, and named "yeast 26." Experiments were carried out with the pure yeast, and the results are as stated in the following:

With Fermentation Tubes: (*a*) A 12% grape-must was inoculated. A gray film formed on the surface, and a large amount of gas collected in the closed tube. The film formed by this yeast differs greatly from the film formed by another variety of yeast described later, namely, yeast 28.

(*b*) Inoculation in a 10% cane-sugar solution: No gas was formed, but after four days a light gray film was formed on the surface and the solution showed a slight turbidity.

(*c*) Inoculation in a Laurent solution containing 1% saccharose: The growth of the yeast was most vigorous, but no gas was produced after an incubation period of nine days. A gray film was formed and the liquid became turbid. The fermentation was carried out at a temperature of 23°C. The microscopical appearance of the yeast was that of an elliptical yeast rather than that of a *Mycoderma;* but it may be stated that this experiment, as well as all the rest in this series of investigations, clearly showed that the general form of the yeast cells was not to be considered a constant, but a variable quantity, which might be said to be a function of the specific medium in which the yeast was grown. This yeast forms, when grown on must-gelatine, cells resembling the cells of a *Mycoderma* form.

(*d*) A fermentation tube containing a must showing 10% Balling was inoculated with the pure yeast. A small amount of gas collected in the closed tube, the liquid became turbid, and a gray film was formed.

For the Determination of Alcohol: (*a*) A must containing 21.67% Balling was inoculated and placed for eighteen days in incubator at a temperature of 23°C. The alcohol was determined by distillation and found to be 3.78% by volume; 12.12% extract was left in the must after fermentation.

(*b*) Laurent's solution containing about 19.68% saccharose was inoculated, and after eighteen days examined. The content of alcohol was found to be 1.14% by volume, leaving 12.71% extract unfermented.

(*c*) A Laurent's solution, with addition of dextrose, was next inoculated. The strength of the solution was 12.84% Balling. Alcohol formed after eighteen days of fermentation was 5.10% by volume, leaving 1.76% extract unfermented.

This yeast formed more alcohol in the artificial dextrose solution than in the must. It has a slight inverting power, and seems to grow in saccharose solution without forming alcohol in considerable quantity.

The yeast is not strictly obligate-aërobic, but rather facultative-anaërobic.

YEAST 28. FROM ZINFANDEL GRAPES.

This is a pure culture of a variety of yeast found on Zinfandel from Tulare Experiment Station.

With Fermentation Tubes: (*a*) Inoculation in a 10% grape-must. After five days at 23°C. no gas appeared; liquid became turbid and a film was formed, differing in appearance from that of yeast 26.

(*b*) In Laurent's solution containing 1% saccharose the yeast produced a gray film, a strong growth, and turbidity; the macroscopical appearance was in every respect similar to that of yeast 26, but the miscroscopical examination showed very long sausage-formed cells, recalling a Pastorianus form.

For the Determination of Alcohol: (*a*) Inoculation in must of 21.67% Balling gave 5.03% alcohol by volume, leaving about 9.00% extract in unfermented form.

(*b*) Fermentation in a Laurent's solution with the addition of saccharose gave, after eighteen days at 23°C., 2.09% alcohol, producing an attenuation from 19.68% Balling to 11.23% Balling.

(*c*) Fermentation in a Laurent's solution to which dextrose had been added until the solution showed 12.84% Balling gave 4.80% alcohol, after eighteen days of fermentation at a temperature of 23°C. The extract left after fermentation was 2.32%.

YEAST 37. FROM ZINFANDEL GRAPES.

If grown in grape-must this yeast forms a thick gray film on the surface.

With Fermentation Tubes: (*a*) 10% saccharose solution. The yeast formed no gas after four days, no turbidity was noticeable, but a slight film formation.

(*b*) Inoculation in a Laurent's solution containing 1% cane sugar gave the same result as the 10% cane-sugar solution above, but also turbidity. The microscopical appearance was the ellipsoideus form.

(*c*) 10% grape-must. No gas was formed in the closed tube; the liquid became turbid, and a film appeared on the surface.

For the Determination of Alcohol: (*a*) Fermentation of must of 21.67% Balling gave, after eighteen days at 23°C., 1.95 alcohol by volume, leaving 16.57% extract in the liquid.

(*b*) Saccharose dissolved in Laurent's solution, showing 19.68% Balling, was reduced to 14.56% Balling. The alcohol formed was only 0.27%.

(*e*) Dextrose dissolved in Laurent's solution gave only 0.13% alcohol. The strength of the solution was 12.84 at the beginning of the experiment. Evaporation during the fermentation process increased the Balling to 13.84%. This explains the fact that 12.82% was found as the percentage of extract in the dealcoholized must.

From the above results it is seen that this yeast has very little fermentative activity. It maintains its life by feeding upon the solid contents of the must, as well as on the saccharose. However, it has no power of utilizing the dextrose. The yeast practically does not form alcohol.

YEASTS 45A AND 45B. FROM ZINFANDEL GRAPES.

A Laurent's solution containing 1% cane sugar was inoculated, and in both cases no gas formation was noticed in the closed fermentation tubes. Both yeasts produced a slight turbidity.

By inoculation in fermentation tubes containing a 10% must, both varieties formed a slight film, but neither gas nor turbidity was noticeable.

In regard to the fermentation, or rather the production of alcohol in two Laurent's solutions, containing respectively saccharose and dextrose, both varieties of yeasts formed practically no alcohol, but reproduction took place.

Analogous experiments carried on in a must showing about 21% Balling gave a result of 1.6% alcohol for the yeast 45A, while 45B gave an amount of alcohol less than 0.3%.

The tests for alcohol were made twenty-five days after inoculation, and the fermentations had in both cases taken place at 23°C.

These two yeasts belonged to the varieties of yeasts found on grapes. They are useless, as far as wine-making is concerned, being unable to produce alcohol or give any bouquet to the wine. Whether both belong to the same variety is difficult to say; the slight differences noticed in their cultural characteristics would hardly suffice to decide this question. However, yeast 45A seemed by far the more active of the two cultures.

YEASTS 46A AND 46B. FROM BURGER GRAPES.

Both yeasts form, when grown in grape-must, a thick, gray film. (*a*) When grown in a pure 10% cane-sugar solution in fermentation tubes, neither of the two varieties formed any gas in the closed tube, after an incubation period of four days at 25°C., but a gray film was present on the surface of the liquid in both cases.

(*b*) When Laurent's solution containing 1% saccharose was inoculated with the yeasts, they were found to be "no-gas" producers. Strong turbidity resulted in both cases. So far the varieties behaved alike, but a microscopical examination showed a great difference in regard to size and form. Yeast 46B had an elliptical form, while yeast 46A was more elongated, forming long chains of cells, and highly reminding of a Pastorianus form.

(*c*) Both yeasts were also tried in fermentation tubes containing a 10% must, but neither film nor gas was noticed; a slight turbidity resulted in both cases.

Experiments to determine whether these varieties formed any alcohol showed that the amount formed in each case was very small. These results will be found in the table. The most characteristic fact is that these varieties differ also in respect to the amount of alcohol formed. Yeast 46A formed about twice the amount of alcohol obtained from 46B, when grown in must. The percentages of alcohol formed in saccharose and in dextrose solutions were in both cases very small.

		Ellip. B. I.	Yeast 26.	Yeast 28.	Yeast 37.	Yeast 45A.	Yeast 45B.	Yeast 46A.	Yeast 46B.
LAURENT'S SOLUTION WITH SACCHAROSE.									
Must	Specific gravity	1.0758	1.0758	1.0758	1.0758	1.0758	1.7058	1.0758	1.0758
	Balling	19.68	19.68	19.68	19.68	19.68	19.68	19.68	19.68
Wine	Sp. gravity of dist	0.99694	0.9983	0.99694	0.9996	0.9999	0.9997	0.9994	0.9996
	Alcohol by weig't	1.66	0.90	1.66	0.21	0.11	0.16	0.32	0.21
	Alcohol by vol.	2.09	1.14	2.09	0.27	0.13	0.20	0.40	0.27
	Ext. dealc. liq.*	12.19	12.71	11.23	14.56	15.53	15.42	15.50	15.92
	Specific gravity	1.0471	1.0491	1.0434	1.0562	1.0599	1.0595	1.0598	1.0614
LAURENT'S SOLUTION WITH DEXTROSE.									
Must	Specific gravity	1.0496	1.0496	1.0496	1.0496	1.0496	1.0496	1.0496	1.0496
	Balling	12.84	12.84	12.84	12.84	12.84	12.84	12.84	12.84
Wine	Sp. gravity of dist.	0.9949	0.9927	0.9931	0.9999	0.9999	0.9997	0.9995	0.9997
	Alcohol by weig't	2.77	4.07	3.81	0.11	0.11	0.11	0.11	0.11
	Alcohol by vol.	3.49	5.10	4.80	0.13	0.13	0.20	0.33	0.20
	Ext dealc. liq.*	5.87	1.76	2.32	12.82	12.56	12.58	12.30	12.52
	Specific gravity	1.0227	1.0068	1.0090	1.0495	1.0485	1.0486	1.0475	1.0484
GRAPE MUST.									
Must	Specific gravity	1.0834	1.0834	1.0834	1.0834	1.0834	1.0834	1.0834	1.0834
	Balling	21.67	21.67	21.67	21.67	21.67	21.67	21.67	21.67
Wine	Sp. gravity of dist.	0.9859	0.9945	0.9929	0.9971	0.9976	0.9996	0.9974	0.9988
	Alcohol by weig't	8.42	3.00	3.99	1.55	1.28	0.21	1.39	0.64
	Alcohol by vol.	10.61	3.78	0.80	1.95	1.61	0.27	1.75	0.80
	Ext. dealc. liq.*	2.69	12.12	11.78	16.57	18.08	18.97	17.77	17.07
	Specific gravity	1.0104	1.0468	1.0455	1.0639	1.0697	1.0731	1.0685	1.0658

*Ex. dealc. liq,: Extract in dealcoholized liquid.

The series of experiments indicate that most of the yeasts found on our California grapes grown in regions remote from wine-making operations are inactive as regards the formation of alcohol; and many of them are detrimental to the wines, producing film formation and turbidity. Most of these varieties also impart an unpleasant flavor and taste, and their general characteristics do not favor the production of a sound wine of good quality. The remedy for repressing the growth of these organisms is to be found in the general introduction and application of pure yeast in California wineries.

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